Quantifying the Value of Non-User Benefits of Improving Water and Sanitation in Informal Settlements

Dorothy Kobel

Thesis presented for the Degree of

DOCTOR OF PHILOSOPHY

in the Department of Civil Engineering

Faculty of Engineering and the Built Environment

UNIVERSITY OF CAPE TOWN

May 2013

Declaration

I, Dorothy Kobel, know the meaning of plagiarism and declare that all the work in this document, save for that which is properly acknowledged, is my own.

Signed: _____ Date: _____

Acknowledgements

The author wishes to thank her supervisors, Prof Romano Del Mistro and Prof Neil Armitage for their meticulous supervision and guidance.

The author would also like to thank the African Centre for Cities, the Faculty of Engineering and the Built Environment of UCT and the National Water and Sewerage Corporation of Uganda for their financial assistance.

Gratitude is also extended to friends and family for their support during the course of the thesis.

All the work undertaken as part of this study, views expressed, and the mistakes therein, are the sole responsibility of the author.

Abstract

This study investigated the value among society of the benefits of improving water and sanitation in informal settlements. The benefits of improving water supply and sanitation have been widely researched, both at a societal and at household level. Why then have the efforts to increase access to services over the last 30 years not achieved the desired results? The value of these benefits, measured through assessments of willingness to pay by the users, is commonly used in investment appraisals as indicators of project viability. In the face of low levels of affordability among the users, as is commonly the case in poorly serviced informal settlements, municipalities have to find alternative avenues of generating revenue to meet their investment and operational needs. One possible avenue is to harness the benefits that are felt by other members of society that do not directly use the service. Examples of such benefits include employer benefits associated with improved health, reduced environmental pollution increased school attendance, among others. These "non-user" benefits, if quantified and incorporated in the pricing structure could potentially increase the resource pool for financing municipal infrastructure.

There is evidence in the transportation and environmental literature that non-user benefits can form a substantial component of total economic value, and that people may be willing to pay for these benefits. There is also evidence that the value of the non-user benefits can be incorporated into policy development and serve as a useful input to decision-making. The concept of non-user value has however not been extensively explored in the urban water sector. This thesis investigated the potential of non-user benefits as drivers of value and applied a stated preference choice model to quantify the trade-offs that "non-poor" residents of the cities of Kampala and Cape Town might be willing to make for public health, environmental, social and economic benefits when levels of service in informal settlements are improved.

In the city of Kampala, the significant component of non-user value was found to be the indirect use value associated with the health benefits of reducing diarrhoeal disease. The study found that the respondents were willing to pay up to 16,528 UGX (2010 USD, 9.86); 13,063 UGX (2010 USD, 7.79); and 18,588 UGX (2010 USD, 11.09) per household per month towards installing communal, shared and yard facilities respectively. The willingness to pay was highest when the informal settlement is located nearest to their neighbourhood and when the payment is collected through a special purpose vehicle. The study found that the benefit cost ratios for improving levels of service in Kampala were 2.91 for communal facilities; 1.41 for shared facilities; and 1.13 for yard facilities. The non-user benefits contributed approximately 54%; 48%; and 57% of the total economic value of installing communal, shared and yard facilities respectively.

In Cape Town, the significant components of non-user value were found to be the indirect use value associated with the health benefits of reducing diarrhoeal disease and the passive use value associated with environmental benefits of reduced pollution of water courses. The study found that the respondents were willing to pay up to R33.06 (2011 USD, 4.06);

R88.59 (2011 USD, 11.21); and R61.04 (2011 USD, 7.73) per household per month for installation of communal, shared, and yard facilities respectively. The willingness to pay was highest when the informal settlement was located near the respondent's neighbourhood. The study also found that the benefit cost ratios were 22.11 for communal facilities and 5.30 for shared facilities. The revenue for the installation of yard facilities was however lower than the costs. The benefit cost ratio of 0.90 for yard facilities implies that the municipality cannot meet the full investment budget for installing yard facilities using the non-user value alone, and would have to find alternative financing to meet the budget deficit.

The study shows that stated preference surveys could be a useful decision making tool for identification of preferences and isolating customer segments, and can be applied by water utility companies and municipalities to improve the planning of informal settlement upgrades. The thesis concludes with recommendations for the improvement of benefit studies in the urban water sector.

Table of Contents

List of Figures

List of Tables

List of Acronyms

ASC	Alternative Specific Constant
BL	Binomial Logit
CoCT	City of Cape Town
COD	Cost of Diarrhoea
CSIR	Council for Scientific and Industrial Research
CV	Contingent Valuation
DIR	Diarrhoeal Infection Rate
DWAE	Department of Water and Environment
DWAF	Department of Water and Forestry
EV1	Extreme value type 1
FBW	Free Basic Water
FGDs	Focus Group Discussions
GDP	Gross Domestic Product
GHS	General Household Survey
GNI	Gross National Index
GoU	Government of Uganda
GTEV	Gross Total Economic Value
IIA	Independence from Irrelevant Alternatives
KCC	Kampala City Council
LOS	Level of Service
MAV	Multi Attribute Valuation
MDGs	Millennium Development Goals
MIG	Municipal Infrastructure Grant
MNL	Multinomial Logit
MoFPED	Ministry of Finance, Planning and Economic Development
NL	Nested Logit
NWSC	National Water and Sewerage Corporation
O&M	Operation and Maintenance
ODA	Overseas Development Assistance
OECD	Organisation for Economic Cooperation and Development
PEAP	Poverty Eradication Action Plan
POL	Pollution Levels
RDP	Reconstruction and Development Program
RUM	Random Utility Model
SDL	School Days Lost
STATSA	Statistics South Africa
TEV	Total Economic Value
UBOS	Uganda Bureau of Statistics
UDHS	Uganda Demographic Health Survey

UGX	Uganda Shillings
UN	United Nations
UNDP	United Nations Development Program
UNHS	Uganda National Household Survey
UNICEF	United Nations Children's Fund
UNWWDR	United Nations World Water Report
USD	US Dollars
UWSS	Urban Water Supply and Sanitation
WB	World Bank
WBCSD	World Business Council for Sustainable Development
WHO	World Health Organisation
WTA	Willingness to Accept
WTP	Willingness to Pay
WUP	Water Utility Partnership

Currency Conversions

Nominal exchange rates assumed in this thesis

1 USD = 1676 UGX (BoU, 2010)
1 USD = 7.9 ZAR (Standard Bank, 2011)

Key Definitions

Sustainability: the definition of sustainable development adopted for this thesis is development that meets the needs of the present without compromising the ability of future generations to meet their needs (UN, 1987). Agenda 21 (1992) includes economic development, social development and environmental protection as essential components of sustainability.

Emergency facilities: the provision of partial access to basic water supply or sanitation, as a first step to alleviate immediate need for municipal water and sanitation services, and as dictated by site-specific constraints (e.g. high dwelling densities). Examples of emergency facilities include chemical toilets, container toilets.

Improved facilities: the definitions in WHO/UNICEF (2008) are adopted for this thesis. Improved sanitation facilities are defined as those that hygienically separate human excreta from human contact. In informal settlements, shared facilities also serve an important role in providing sanitation to households, and are described as improved facilities that are shared between two or more households. Examples of shared facilities include public toilets. Improved drinking-water facilities: are defined as one those that, by nature of construction or through active intervention, are protected from outside contamination, in particular from contamination with faecal matter.

Institutional capacity: the description as adopted from Agenda 21 (1992) is an assessment of an institution's ability to operate and deliver mandated services. It involves an assessment of the human resource available (including technical knowledge and skills); inter-organisational aspects (such as relationships and networks with other relevant organisations; intra-organisational aspects (the availability, and operationalization of key processes and systems within the organisation); and an assessment of the regulations and policies that govern the institution.

Consumer surplus: is an economic term that represents the difference between the maximum willingness to pay for a good/service and the market price of that good/service.

1. Introduction

1.1 Background

For over four decades the world has made concerted efforts to improve access to water and sanitation among the portions of the population that are poorly served; declarations such as the International Decade for Clean Drinking Water (1981-1990) and more recently the International Water Decade (2005-2015) have been used to draw attention to and accelerate investments in the water sector. The Millennium Development Goals (MDGs) call for halving the proportion of the population without access to safe drinking water and adequate sanitation between 1990 and 2015 (WHO/UNICEF, 2008). At a global level, significant progress has been made: access to safe drinking water increased from 76% in 1990 to 89% in 2010; and access to improved sanitation increased from 49% in 1990 to 63% in 2010 (UNICEF & WHO, 2012). In African countries however access to water and sanitation services still remains low, and there are concerns that the MDGs will not be met, especially in sub-Saharan Africa (UNICEF & WHO, 2012; WHO/UN-Water, 2010). Global estimates show that about 800 million people are still without access to safe water, of which 40% live in sub-Saharan Africa. Sanitation coverage is much worse, with an estimated 2.5 billion people living with unimproved sanitation (UNICEF & WHO, 2012). In urban areas, the improvement in access to water and sanitation facilities has been retarded by high population growth (UNICEF & WHO, 2012; UN Habitat, 2010). Global estimates show that while there was a 60% increase in access to safe water between 1990 and 2010, there was also a 20% increase in the number of people using unimproved facilities (UNICEF & WHO, 2012).

In sub-Saharan Africa, most of the population growth in urban areas is among the low income population who reside in poorly serviced neighbourhoods with basic engineering and social infrastructure, inadequate housing and high levels of poverty (UN Habitat, 2011). Poor planning and weak institutional structures have resulted in large disparities between access to water and sanitation services among the rich and poor portions of the cities: 90% of the richest 20% of the urban population in sub-Saharan Africa have access to improved services while only 42% of the poorest 20% have access (UNICEF & WHO, 2012). These disparities generate high social and economic costs not only for the poor, but for society as a whole (UN Habitat, 2011). Promoting social development and economic growth in sub-Saharan cities must therefore aim to bridge the service delivery inequalities through policies that encourage redistribution of the benefits of engineering infrastructure and affordable housing for the poor (UN Habitat, 2011; UN Habitat, 2010).

The costs of poor water supply and sanitation to a society are high, including: high deaths rates from diarrhoeal disease, high economic costs resulting from lost time in fetching water and time away from work, and high levels of environmental pollution, among others (World Bank, 2008). It is estimated that water and sanitation related diseases cause at least 2 million deaths among children every year (WHO, 2008). Furthermore, women and children

bear the highest burden of fetching water, at great opportunity cost to their time which could be spent in school or on income-generating activities (UNICEF & WHO, 2012; Brook & Smith, 2001).

The benefits of improving access to water and sanitation are high; studies show that every dollar invested in water and sanitation yields between 2 and 34 USD in economic benefits (Hutton & Haller, 2004; Saunders & Del Mistro, 2004). In spite of these potential benefits though, developing countries are unable to meet the financing requirements to cope with the rate of population growth and backlog in investment (WHO & UNICEF, 2004). Competing demands for meagre resources often result in low fiscal allocations which incapacitate the water utilities' ability to meet the expansion costs and operation and maintenance (O&M) requirements (World Bank, 2008). Also, aid for water and sanitation projects has declined since the mid-1990s (WHO/UN-Water, 2010). The traditional way of financing water and sanitation from central governments and development aid are no longer adequate (OECD, 2011b; Estache, 2004; Winpenny, 2003). Municipalities need to identify own-source funding opportunities in order to gain financial autonomy and minimise their dependence on public transfers and development aid (OECD, 2011b; UN-Habitat, 2010). One such avenue is to explore the possibility of incorporating the willingness among the members of society that can afford, to pay for the benefits of improving services to the poor.

The research presented in this thesis quantifies the willingness of the non-poor members of society to pay for improving levels of water and sanitation service in informal settlements. The subsequent sections of this chapter present the justification of the research; the objectives of the study and finally outline the structure of the thesis.

1.2 Justification for the research

Many utility companies in developing countries are faced with the financial challenge of meeting the water and sanitation requirements of a growing population of customers that cannot pay, while still meeting the needs of existing customers (UN Habitat, 2011; Brook & Smith, 2001). Water service providers have for a long time relied on user charges (sometimes with public subsidies and development aid) to finance operation, maintenance and/or rehabilitation and expansion activities (Estache, 2004). Concerns for affordability and access to the poor are usually cross-subsidised through tariffs as a subsidy on consumption bills and/or a subsidy on the capital costs (Estache, 2004). The success of tariffs in revenue generation and in targeting the subsidies to the poor is highly dependent on the pricing structure used and the size of the paying population (Komives *et al.*, 2007), and should be guided by assessments of the willingness to pay for the service (Foster *et al.*, 2000).

A consumer's willingness to pay is driven by the value attached to the service, which is a measure of the trade-off between the benefits (real or perceived) and the cost of access to the service (Gutanilake *et al.*, 2007). Conventional willingness to pay studies target the direct user

of the service, and any such benefits that are realised by other parties (non-users) as a result of the improvement in service are not always fully reflected in the tariff structure (WHO, 2012; Massarutto, 2009; Bowers & Young, 2000). However, there are benefits (such as social and environmental benefits) that are traditionally excluded from valuation studies because they are a challenge to link to beneficiaries; are difficult to quantify in monetary terms; and are also only fully realised beyond the discounting period used in financial and economic analyses (Hutton, 2012; Whittington & Hanemann, 2006; Raucher *et al.,* 2005; Bowers & Young, 2000; Rogers *et al.,* 1998). The result has been a continuous cycle of understatement of value which has led to consistent under-funding for expansion and maintenance of infrastructure (Moss *et al.,* 2003).

Sustainability in service delivery demands that water is managed as a scarce resource with economic value; that externalities are accounted for; that collective affordability and affordability by the poor are taken into account; and that management and planning decisions are transparent and accountable (Massarutto, 2009). Transforming these requirements into practice calls for value assessments that incorporate the costs and benefits to all stakeholders (Muller, 2008; van der Zaag & Savenije, 2006; Hutton & Haller, 2004). The question then arises as to who else stands to benefit when service levels of the poor are improved and whether they are willing to pay for those benefits.

There is evidence in transportation and environmental research that the non-user value of goods and services can form a substantial component of Total Economic Value (TEV) and, if included, could change the outcome of valuation studies (Laird *et al.,* 2009; Rogers *et al.,* 1998; Crowards, 1995; Weisbrod, 1964). There is however limited empirical research into the measurement of non-user benefits of urban water and sanitation services and their potential contribution to financing infrastructure needs (Hutton, 2012). Furthermore, the methodologies commonly used to value non-user benefits have not been extensively applied in water studies as in the transportation and environmental fields, among others (Whittington, 1996). This study attempts to apply these methodologies to identify and quantify the value of non-user benefits of improving levels of service in informal settlements in sub-Saharan Africa.

1.3 The objectives of the research

The primary objective of the research was to investigate the potential of non-user value in increasing the resource pool for financing of water services. In order to capture context-specific information, two cities of different socio-economic and urban characteristics were identified as case studies. The study focussed on improving levels of service in informal settlements in Cape Town, South Africa and Kampala, Uganda.

The secondary objectives were:

- To identify an appropriate typology of total economic value and thus the components of non-user value that are appropriate in the urban water context; and
- To develop an appropriate stated preference method to identify and quantify the non-user benefits of improving the levels of water and sanitation services in informal settlements.

1.4 Contribution of the thesis

Reducing poverty and improving access to water and sanitation have been on the international policy agenda for over 40 years. There have been several calls for: innovative solutions to increase financing, enhancement of participatory decision-making and the development of pro-poor policies that address the service delivery challenges faced by municipalities (UN Habitat, 2011; Winpenny, 2003; Serageldin, 1994). This thesis envisaged developing a valuation method that can be employed to increase stakeholder participation in planning and financing infrastructure in informal settlements.

Researchers and practitioners involved in municipal service delivery commonly have to solve challenges with limited information and empirical data (WHO & UN-Water, 2012). African cities are characterised by complex societal interactions driven by differences in culture, ethnicities, socio-economic levels and political influences (UN Habitat, 2010). It is recommended that any studies on African cities should be context-specific in order to capture the specific influences that may be unique to the city under evaluation (UN Habitat, 2010). By applying the valuation method, this thesis provided empirical evidence of the drivers of value in two cities. The findings of this study can be used to support future valuation studies and policy planning.

1.5 Delimitations of the scope of this research

Municipal services typically include a combination of engineering services (such as roads, water supply, transportation, sanitation, stormwater drainage, electricity, etc.) and social and community services (such as public spaces, street lighting, health and education services, etc.). This study has focussed on the delivery of water and sanitation services only. It is acknowledged that upgrading of much other physical and social infrastructure is required if sustainable results are to be realised. For example, stormwater drainage is an integral part of the urban water system and its inclusion in this study would have provided a more holistic study into the urban water challenges in informal settlements. This study opted not to include stormwater services as part of the valuation package for a number of reasons: firstly, in both cities that were studied, the stormwater and water systems are managed by different departments, and secondly due to differences in the temporal and geographical locations of the impacts of poor water and stormwater services (e.g. the impact of poor water services are faced on a daily basis whereas the impacts of poor stormwater management are seasonal). Since this

study required the respondents to answer a hypothetical scenario of level of service improvements, it was thought that including an additional hypothetical question that would require them to pay for stormwater services as part of the water and sanitation bill would increase the level of complexity of the study.

1.6 Structure of the thesis

Chapter 2 is a review of the available literature that is pertinent to the study. The chapter includes a brief account of the international policy discussion on increasing access to water and sanitation. Emphasis is made on the impact of these policies on the poor. Economic theories that support the valuation of non-user benefits are used to make a case for application in the urban water sector. The chapter concludes with selected cases studies where the value of non-user benefits has been applied, either in policy or in empirical research. **Chapter 3** examines the methods that are appropriate for valuation of non-user benefits in a developing city context. The survey development is drawn from stated preference methodology applied in the transportation and environmental literature, and contextualised using literature on willingness to pay studies in the urban water sector in developing countries. **Chapter 4** presents the application of the method to the city of Kampala in Uganda. Details involved in the survey development and experimental design; inputs to survey preparation and implementation; and the analysis of the data are also discussed. **Chapter 5** presents the survey application and analysis for the City of Cape Town in South Africa. **Chapter 6** synthesises the outcomes from the two studies, discusses the robustness of the method and the potential application of the results in valuation studies. **Chapter 7** summarises the findings of the study, highlighting lessons learnt and proposes recommendations for future research.

2. Literature review

This chapter presents a discussion of the principles and practice of the delivery of urban water and sanitation services. The challenges faced by municipalities in the provision of water and sanitation services in informal settlements are also discussed, with emphasis made on the impact of poor services on the poor. The disparity between the objectives intended by water policies, which are normally economic and social in nature, and the channels used to finance these policies, which are normally based on financial or political decisions (OECD, 2009; Moss *et al.,* 2003) are used to highlight the need to incorporate the value of non-user benefits into investment appraisals.

This chapter also discusses the theory on valuation of non-user benefits as interpreted from the transportation and environmental literature. In order to identify relevant components of non-user value, the concept of total economic value is evaluated and applied to the context of urban water and sanitation services in a developing city. Valuation methodologies and the theory of choice modelling are also presented as a precursor to development of the data collection method that is presented in Chapter 3. The final section of this chapter presents empirical evidence that supports the valuation of non-user benefits.

2.1 Understanding urban water and sanitation services

"…..water binds…..water travels the full cycle endlessly again and again. Only one way to treat water is with wisdom…" (Heun, n.d)

2.1.1 Urbanisation and service delivery

There is a link between urbanisation, the provision of municipal engineering services (such as water supply and sanitation, roads, stormwater drainage, etc.) and the social and economic development of a society (UN Habitat, 2010; WSP, 2004). During the industrial revolution in late 18th to 19th century Europe, high urbanisation rates created a demand for housing and municipal services and, as the pressure to meet the demands of the increasing working population increased, it became critical to improve the management of the land and natural resources (Garrett, 1994). For example in London, the decision to manage the water supply as a public service is reported to have stimulated slum upgrading through road construction and improved housing conditions (Nilsson, 2003; Garrett, 1994). The conglomeration of people in the cities also provided an avenue for collective action for better living conditions. For example, through the public health movement that was borne as a result of a series of cholera outbreaks in the 20th century, many cities in Europe and the Americas accelerated investment in municipal infrastructure which resulted in improved health and sanitation conditions (Garrett, 1994).

Developing countries have only faced rapid urbanisation in the last 50 years (UN Habitat, 2010), and are currently experiencing higher volumes of population growth than developed countries in the 19th century (Martine, 2011). It is estimated that, collectively,

cities in developing countries grow by an average of five million residents every month and that by 2030, over 60% of the developing country population will reside in urban centres (UN Habitat, 2008). As discussed in the preceding section, urbanisation can provide the size and scale to promote socio-economic development and expansion of municipal services (Martine, 2011). For example, between 1990 and 2010, coverage of urban water supply and sanitation in developing countries increased by 2% and 15% respectively (see Table 2-1). Coverage of improved sanitation in sub-Saharan Africa increased by 15%; attributed mostly to growth in shared sanitation facilities (UNICEF & WHO, 2012). The rate of increase in urban water coverage is however stagnant, attributed to an increasing population growth (UNICEF & WHO, 2012).

Table 2-1: Coverage of urban water and sanitation in developing countries

	Sub-Saharan Africa		**Developing countries**		**World**	
	1990	**2010**	**1990**	**2010**	**1990**	**2010**
Urban population (% of total population)	28	37	35	45	43	51
Urban water coverage (%)						
Level of water service	**Sub-Saharan Africa**		**Developing countries**		**World**	
	1990	**2010**	**1990**	**2010**	**1990**	**2010**
On-site water source	43	34	72	73	81	80
Other improved	40	49	21	22	14	16
Unimproved	14	14	6	5	4	4
Surface water	3	3	1		1	-
Total	100	100	100	100	100	100
Urban sanitation coverage (%)						
Level of sanitation service	**Sub-Saharan Africa**		**Developing countries**		**World**	
	1990	**2010**	**1990**	**2010**	**1990**	**2010**
Improved sanitation	43	64	65	73	76	79
Shared sanitation	28	18	13	17	10	13
Unimproved	19	8	12	6	8	5
Open	10	10	10	4	6	3
Total	100	100	100	100	100	100

(UNICEF & WHO, 2012)

Where population growth is not matched by expansion of municipal services, urbanisation can result in areas with high concentrations of environmental pollution and poverty (Martine, 2011; Moreno, 2011) and in social and political instability (UN-Habitat, 2010). In many African countries, inadequate financial resources, poor institutional capacity to expand

and manage municipal infrastructure, coupled with low political prioritisation of municipal service delivery has manifested into environmental and social degradation and generally a low quality of life for a large portion of the population (UN-Water/Africa, 2006). In sub-Saharan Africa, the highest rate of urbanisation is taking place among the low income population, as is evidenced by the high growth of informal settlements in cities (WUP, 2003). It is estimated that almost 62% of the urban population in sub-Saharan Africa live in informal settlements (UN Habitat, 2008:90). Informal settlements are characterised by *inter alia*, high levels of poverty, poor housing, poor distribution of municipal services and lack of essential services such as health care and education (UN Habitat, 2008). There are various explanations for the poor services in informal settlements: issues of affordability may inhibit access to services; contextual or cultural conditions may limit the technical options (e.g. the use of certain sanitation technologies); the regulatory and institutional environment in the city may influence social acceptability (e.g. tenure issues may prevent the utility companies from providing services to land that is illegally occupied); and insufficient public participation may affect the social acceptance of service interventions(Bosch *et al.*, 2001). In order to realise the potential benefits of urbanisation, cities in sub-Saharan Africa will need to improve efficiency in governance and planning, expansion of housing and engineering infrastructure and delivery of services that foster an enabling environment for development, especially among the poor (UN Habitat, 2010).

2.1.2 Delivery of water and sanitation services: principles and practice

The urban water system is a combination of the physical infrastructure required to provide water, dispose of waste and stormwater; and the management system required to ensure operation of the infrastructure. Urban Water Supply and Sanitation (UWSS) services are part of the urban water system that deal with provision of water and sanitation services for residential, institutional, industrial, commercial and municipal use. The provision of UWSS services requires the construction of physical infrastructure and the regulatory and institutional policies that would ensure adequate management of the infrastructure. Each of the categories of demand of the urban water system has different requirements with respect to quantity and quality as summarised below:

i. Residential water, comprising of drinking and domestic water. Residential water covers water used for basic needs such as water for health and hygiene. Quality and quantity requirements are important to minimise the risk of disease and contamination.

ii. Water for industry, referring to water required as part of industrial processes. The level of quality and quantity required is dependent on the type of industry served.

iii. Water for environmental needs, comprises water necessary to support ecosystems and maintain biodiversity, including processes required to negate the impacts of pollution.

iv. Water for fire fighting, street cleaning and maintaining public spaces, among others.

Delivery of water and sanitation for residential purposes requires definition of levels of service that will achieve acceptable standards and quality of life while remaining within affordability levels of both service providers (municipalities) and users (WHO/UNICEF, 2008). Levels of service are usually defined based on consideration of the following:

i. Type of technology (e.g. public standpipe, in-house tap, latrine, in-house flush toilet).
ii. Accessibility to the service (e.g. in-house, in the yard, at a distance from the dwelling).
iii. Quality of service (e.g. reliability of supply, customer response quality).
iv. Social acceptance (e.g. acceptance from the beneficiaries and/or the users of the proposed technology, the proposed payment method and the management system, etc.).
v. Level of operation and maintenance required.
vi. Affordability of the users to pay for the service.
vii. Sources of funding available to the service provider.

WHO/UNICEF (2008) describe the preferred level of service interventions for developing countries. They use the criteria described above (i.e. effectiveness *viz* health and social benefits, installation and maintenance cost, and technical feasibility) to describe "improved" and "unimproved" facilities as shown in Table 2-2.

An improved water source is a technological intervention that has improved the likelihood of providing safe water. Examples include in-house connections, public standpipes, boreholes, protected wells or springs, and rainwater collection. In comparison, an unimproved water source such as vendors, tanker trucks, unprotected wells and springs do not guarantee provision of safe water. Access to an improved source refers to the availability of at least 25 litres per person per day from an improved water source within one kilometre of the dwelling (WHO/UNICEF, 2008). Facilities that are costly, e.g. bottled water and water supplied by tanker trucks are also described as "unimproved". Water professionals are faced with the challenge of providing services amidst threats of water security, climate change impacts, and increasing regulatory and customer requirements, whilst maintaining affordability levels and keeping equity and societal objectives in mind (Raucher *et al.*, 2005). Agenda 21 (1992) and the International Conference on Water and the Environment in Dublin (ICWE, 1992) introduced the concept of the value of water, and recommended treating water as an economic good that has value in its competing uses. The practical interpretation of this recommendation would mean that economic theories should apply to the analysis of water services (van der Zaag & Savenije, 2006). The Dublin recommendation (ICWE, 1992) sparked discussion over the potential impact of the application of economic theory to a good that is not substitutable and that has life supporting value, especially its impact on the poor (van der Zaag & Savenije, 2006; Rogers *et al.*, 1998). A summary of the basic principles of public good theory are presented in Box 2-1 (see Hanemann, 2005; Bowers & Young, 2000; Ostrom & Ostrom, 1977).

Table 2-2: Level of service options

Municipal Service	Description of Service
Water	**Improved sources** e.g. • Piped water on premises: in-house taps, taps located on the plot or yard.
	Other Improved e.g. • Public standpipes, tube wells or boreholes, protected wells & springs and rainwater harvesting.
	Unimproved sources e.g. • Unprotected wells and springs, surface water (river, dam, lake, etc.), water that is carried from the primary source to user (tanker truck).
Sanitation	**Improved facilities**(achieves separation of excreta from human contact) e.g. • Flush or pour-flush toilet/latrine to sewer system or septic tank. • Pit latrine: Ventilated improved pit latrine or pit latrine with slab. • Composting toilet.
	Other Improved i.e. shared facilities (between two or more households) e.g. • Shared toilets, shared latrines, public toilets.
	Unimproved facilities (do not achieve separation of excreta from human contact) e.g. • Pit latrines without a slab. • Bucket latrines.
	Open defecation (defecation in the open environment or disposal of faeces with solid waste).

(WHO/UNICEF, 2008)

Researchers argue that water services exhibit a mix of public, private and mixed good characteristics, and often result in a phenomenon called "market failure" (UN-Water/Africa, 2006; van der Zaag & Savenije, 2006). Market failure is said to occur when the conditions of a competitive market (i.e. excludability and rivalry of goods / services) are violated and resources are used inefficiently (van der Zaag & Savenije, 2006). There are also other considerations that may not favour the attachment of a market price to water services. Firstly, the high investment requirements of water and sanitation infrastructure often favour the development of monopolies (which would violate the principles for a competitive market), and secondly, there are some functions of the urban water system such as provision of water to the poor, water for agriculture and protection from pollution, which due to their high societal value should not be priced on the basis of market forces alone (Mader, 2011; van der Zaag & Savenije, 2006).

2.1.2.1 Water services and market failure

For a water market to function, water services would have to be treated as a private good, i.e. highly rivalrous (access by one person reduces the availability of the service to another person) and highly excludable (it is possible to prohibit access to others). Water services have

been shown to possess a mixed degree of rivalry and excludability (Mader, 2011; van der Zaag & Savenije, 2006; Bowers & Young, 2000) as described below:

Box 2-1: Definitions of public goods

Pure public goods are goods/services whose consumption produces benefits that cannot be excluded to individuals and whose consumption by an individual does not reduce possible consumption by others. Typical examples of pure public goods are air quality, national defence, etc. Private goods on the other hand produce benefits that are excludable between individuals and for which consumption by one reduces their availability to another. Typical examples of private goods include food, manufactured goods, etc. Pure private goods are commonly traded in a market scenario, based on demand and supply. When describing public and private goods, it is important to introduce the concept of externalities:

- A positive externality is said to occur when the consumption of a good by one party produces a benefit to a third party without any compensation to the first party e.g. re-forestation.
- A negative externality conversely occurs when the consumption of a good produces a cost to a third party without the consent of, or compensation to the third party e.g. environmental pollution.

The occurrence of externalities symbolises a failure by the market to adequately "exclude" benefits of a private good and thus allocate costs and assign payment for the benefits. Such goods, that are neither purely public nor purely private goods (called mixed goods), can fall into two categories:

- Goods that are either non-excludable or costly to exclude but whose consumption can suffer from over-use or congestion e.g. fishing grounds, natural resources such as timber, coal (common pool resources); and
- Goods that are excludable but whose consumption could become competitive at congestion e.g. cinemas, satellite TV (club or collective goods).

(Hanemann, 2005; Bowers & Young, 2000; Ostrom & Ostrom, 1977)

The Non-Rivalrous Nature of Water Services: In a non-rivalrous scenario, access by one person does not reduce the availability of the service to another person (e.g. listening to a radio broadcast). The opportunity cost (to the third party) of accessing a non-rivalrous good is zero. Water services however produce several third party costs and benefits:

i. Consumption of contaminated water may lead to epidemics such as cholera and diarrhoea, thus creating a high societal cost. The public health benefits of providing potable water for drinking and hygiene purposes would warrant water services as a public good.

ii. Water used for municipal purposes such as fire fighting offers public benefits through controlled risk of spreading of fires, thus protection of life and property.

iii. Water and sanitation services produce both large positive and large negative externalities. Positive externalities are exhibited through prevention of environmental pollution and prevention of epidemics caused by exposure to contaminated water. Negative externalities associated with water services arise from bi-products of water treatment and over-exploitation of water resources. Negative externalities associated with

sanitation services arise from the release of untreated waste into the environment resulting in increased health and environmental costs to downstream users.

The Non-Excludable Nature of Water Services: In a non-excludable scenario it is not possible to prohibit access to the service. UWSS services in developing cities are commonly provided through a combination of a piped water network, point sources informally run by commercial vendors and through commercially bottled water (UN-Water/Africa, 2006; Whittington, 2002). Access to water through the informal markets and through bottled water exhibits private good characteristics through price exclusion (van der Zaag & Savenije, 2006). Water services have also been seen to exhibit properties of a mixed good, as follows:

i. Water services exhibit characteristics of a "club" good, e.g. in cases where disconnection from supply is used as a penalty for non-payment of bills (MacDonald, 2002).

ii. Water services can also exhibit characteristics of a "common pool resource", e.g. in cities that ration water supply due to scarcity of production.

iii. Many cities in Africa do not have 100% geographical coverage of the water and sanitation networks. In such cases, a lack of economy of scale can prohibit expansion of the network (e.g. in a case where a community that lives outside the reach of the network cannot be connected to the central water or sanitation system due to the technicalities or costs associated with expansion of the network boundaries), thus exhibiting good characteristics.

2.1.2.2 Water for sustainable development

It has been argued that the development of policies on the basis of water as an economic good would inhibit access to the poorer population who may not be able to afford to pay for the services, and that water should be treated as a social good (UN-Water/Africa, 2006; van der Zaag & Savenije, 2006). Policies developed on the basis of water as a social good would require that decisions pertaining to service delivery are made through public participation or political processes (Nilsson, 2005). The role of governments in ensuring access to water services is further strengthened by the declaration of water supply as a basic human right, which creates an entitlement and thus holds governments responsible for the provision of sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses (UN CESCR, 2003). Several organisations and water authorities have developed guidelines that attempt to define the stakeholder responsibilities and the criteria that would guarantee accessibility in a manner that is considered safe and adequate. For example, the minimum requirement stipulated by the WHO for basic needs is 25 litres per capita per day (WHO/UNICEF, 2008) whilst the maximum distance from a household to a communal tap in South Africa is set at 200 m (CSIR, 2000). Basic need, as defined by WHO/UNICEF (2008) is water required for drinking, food preparation and personal hygiene. The United Nations General Comment 15 addresses issues of affordability and equity by stating that deprived urban areas should have access to water facilities, with no household

denied the right to water (UN, 2003). The General Comment 15 further stresses the need to ensure affordability of water, advising the use of appropriate pricing and even free water to ensure equity (UN CESCR, 2003).

The Millennium Development Goals (MDGs) of 2000 were set to provide common targets towards poverty reduction, environmental protection and social development. The emphasis on stakeholder participation and incorporation of social and environmental concerns in the planning and management of water services saw the notion of sustainability in service delivery take root (Hemson *et al.,* 2008). Sustainability in service delivery demands that the economic, financial, environmental and social objectives of the society are incorporated in service delivery plans, and requires that some level of cost recovery is attained towards (at the least) operation and/or maintenance of the services (Hemson *et al.,* 2008). The decade from 2005 to 2015 was declared the "International Decade for Action" with the aim of emphasising the role of water in sustainable development and poverty eradication and of accelerating investment in water and sanitation (Hemson *et al.,* 2008). On the global scale, significant progress has been made towards reducing poverty and increasing access to water and sanitation (WHO/UNICEF, 2008). Sub-Saharan Africa is however recording slow progress, and unless substantial additional investments are made, many countries in the region will not meet their MDG targets (WHO/UNICEF, 2008).

2.1.3 Water services and urban poverty

One of the common definitions of poverty is the inability to meet basic needs such as food and shelter; and the deprivation of basic services such as water, sanitation, and medical services (UN, 1995). There is a definite link between the presence of safe water and adequate sanitation and improvement in health and reduction of poverty (UN-Water/Africa 2006). Poor water resource management and low coverage of water and sanitation manifests in the spread of waterborne diseases (mostly cholera and diarrhoea), which in turn result in loss of productive time among adults, loss of school time among children, high costs of treatment of disease and for transport to health centres, and increased morbidity and mortality due to disease (OECD, 2011a; Esrey *et al.*, 1990; Whittington, 1989). Figure 2-1 illustrates some of the impacts of poor water and sanitation on the poor. In the absence of access to the municipal water network, the poor pay large amounts for services provided through informal markets and vendors (UN-Water, Africa, 2006; Gulyani *et al.,* 2005). Studies find that the urban poor spend between 9% and 20% of their income on water, compared to 5% or less among the middle and higher income population (World Bank, 2008; UN Water Africa, 2006). These high costs only serve to deepen poverty and increase vulnerability to external influences. Studies have shown that households in poorly serviced areas cannot save or trade off their income for any extra or unforeseen household expenditure. For example, a study in Dar es Salaam, Tanzania showed that a three-day water shortage would send an additional 10% of the population below the poverty line (de Waal, 2003); another study in Mombasa and Nairobi, Kenya, showed that the poor preferred to spend more time fetching "free" water from (sometimes contaminated) springs

than to incur costs at the water kiosks (Gulyani *et al.*, 2005); while another survey showed that poor households in Grabouw, South Africa will trade off payments towards water for payments for food and electricity (Peters & Oldfield, 2005).

African countries recognise the need for strengthening the financing base for water while ensuring cost recovery, equity and addressing the needs of the poor (UN-Water/Africa, 2006). With evidence that the poor cannot afford to pay for improvements in water services, the question of financing services through other avenues comes into play (OECD, 2011b; Bosch *et al.*, 2001). Studies show that society as a whole incurs costs from inadequate levels of service. Societal costs include civil unrest, e.g. in Delmas, South Africa where protests broke out after water shortages resulted in several cases of typhoid fever (Sidley, 2008); and in Bolivia where protests were staged against an increase in water tariffs (Schultz, 2000). The private sector also incurs costs through reduced work time, reduced productive capacity and reduced purchasing power due to disease (WBCSD, 2008). Environmental costs are also high; untreated wastewater damages water courses and threatens irrigation and agricultural activities downstream (River Health Programme, 2005; Bosch *et al.*, 2001).

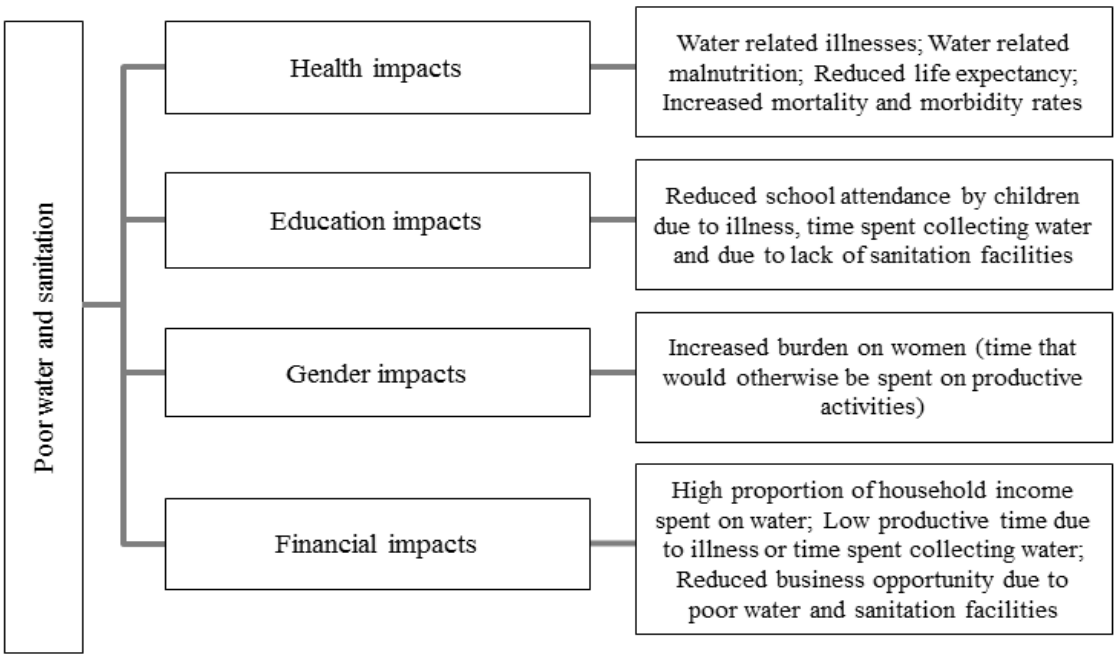

Figure 2-1: The impact of poor water and sanitation on poor households
(Bosch *et al.*, 2001)

Conversely, improving access to water services has been shown to increase socio-economic development through improved quality of life from improved health and productive life and through reduced environmental degradation among others (Parikh, 2008; WSP, 2004). A list of potential benefits from improving water and sanitation services is shown in Table 2-3. Studies show that there are high benefit cost ratios for investments in areas where water and sanitation facilities are lacking; every dollar invested yields between 2 and 28 USD in

economic benefits (UN-Water & WWAP, 2006; Hutton & Haller, 2004; Saunders & Del Mistro, 2004).

Table 2-3: Benefits of improved levels of water services

Benefit	Examples
Benefits to the Users	- Health benefits arising from having access to clean and safe drinking water - Reduction in costs spent on treatment of water borne disease - Time savings arising from having access to water supply closer to the household - Protection of environment through adequate collection and treatment of wastewater - Increased property values
Benefits to Employers	- Reduced tax burden on health and social sector expenses - Lower human resource costs due to reduction in number of unhealthy staff - Lower unit cost of production due to reduced absenteeism of unhealthy staff from work - Higher school attendance and therefore high education levels of labour force - Increased aesthetic quality of the environment due to reduced pollution from poor sanitation - Increased property values - Reduction in civil protests therefore increased security - Reduced environmental damage - Better international image therefore increased tourism, high incentive for foreign investment, job opportunities
Benefits to Society	- Reduced tax burden on health and social sector expenses - Satisfaction derived from knowing that family members, friends or vulnerable members of society such as the sick, that live in informal settlements have improved services. - Reduced burden on women and thus increased time for women to engage in other productive activities. - Satisfaction with respect to social equity - Higher school attendance and therefore high education levels of labour force - Increased aesthetic quality of the environment due to reduced pollution. - Increased property values - Reduction in civil protests therefore increased security - Reduced environmental damage - Better international image therefore increased tourism, high incentive for foreign investment, job opportunities. - Desire to maintain environmental integrity for future generations - Feeling of pride at high minimum level of service in the city

(OECD, 2011a; Okun, 1998)

In the face of rapid urbanisation, high levels of poverty and threats of climate change, it is imperative that UWSS services are managed with sustainability and social equity in mind (UN Habitat, 2010; Bosch *et al.,* 2001). The traditional supply-driven approach involves municipalities providing the water and sanitation services with minimal input of societal concerns, e.g. with respect to standards of service or environmental pollution. The concept of integrated urban water management recognises the close relation between the elements of the urban water system and society, and promotes the holistic management of urban water

components to incorporate environmental and societal objectives (UN-Water & WWAP, 2006). Some water managers are thus adopting demand-driven approaches that incorporate elements such as water conservation and environmental protection that respond to the social and economic context of the society. This implies that policy and investment decisions are informed by consumers' needs and are matched with their willingness and ability to pay for the service (Bosch *et al.,* 2001). One of the challenges faced by municipalities is to get society to link the benefits with the full costs associated with the service (Moss *et al.,* 2003). For example, people are typically more concerned with the quality of their residential water and are thus more willing to pay for safe and reliable water supply than waste water disposal and treatment (Raucher *et al.,* 2006). Furthermore, not all the costs and benefits of water services are measured, e.g. the difficulties associated with isolating benefits of improved health to improved water and sanitation render their exclusion from benefit studies (OECD, 2011a; Moss *et al.,* 2003). The conventional benefit assessments thus compute only the costs and benefits that apply to the direct user / consumer of the services, and do not link the indirect benefits or externalities (Hutton, 2012).

2.2 Constraints to the delivery of water and sanitation services to informal settlements

One of the key objectives of water policy is to protect water resources while meeting the water supply needs of the population (OECD, 2009). This requires a balance between meeting the needs of population growth coupled with the demands for higher standards of living, while still maintaining the environmental integrity of systems. In order to meet these requirements, municipalities have to incorporate the engineering, physical and urban planning, social and ecological aspects of service provision. The section below discusses the challenges that municipalities face in balancing these aspects.

2.2.1 Physical and technical constraints

Informal settlements are often located in marginalised areas which are either unsuitable for development (e.g. flood plains, abandoned landfill sites); on public land that has been allocated to specific uses (e.g. road reserves, easements of sewer pipelines, public open spaces, etc.); or on private land that has been subject to squatter settlement (UN Habitat, 2010; Majale, 2002). Access to tenure has been identified as one of the biggest obstacles to improving services in informal settlements (UN-Habitat, 2010; Majale, 2002). In cases where informal settlements are located on private land and the local authority is required to obtain permission from the land owner prior to any infrastructure provision (e.g. in Cape Town), land owners are reportedly hesitant to give permission for fear of making the informal settlements permanent (Mels *et al.,* 2008). Also, in cases where provision of sanitation services is a household responsibility (e.g. in Kampala), private landlords have been reported to neglect the provision of these facilities, leaving their tenants without facilities (such households find alternative options such as paid public facilities or open defecation) or with poorly constructed facilities (UN-Habitat, 2007). Furthermore, the

insecurity caused by fear of eviction incapacitates the residents of informal settlements from proactively improving their living conditions (UN-Habitat, 2010; Mels *et al.*, 2008).

There are also challenges associated with the choice of technical options that suit the prevailing geographical and socio-economic conditions (UN-Habitat, 2011). The selection of appropriate technologies that are in line with levels of affordability and are socially and culturally acceptable to communities is of vital importance to the lifespan of the infrastructure and for the realisation of the intended benefits (Parikh, 2008). The minimum level of service aims at providing clean water at a set maximum distance from the household (usually between 100 and 250 m) through communal taps (UN-Water/Africa, 2006). There has however been debate around this minimum level of service and whether it is able to deliver adequate services (UN-Water/Africa, 2006; Hutton & Haller, 2004). In settlements of high housing density, a single standpipe serving residents within a 250 m radius could serve several households, resulting in long queues at the tap and thus negating any time saving benefits that could have been realised from having facilities brought closer to the households (UN-Water/Africa, 2006).

The most common level of sanitation among the low income population in many municipalities in sub-Saharan Africa is the dry toilet, particularly the pit latrine. Other forms of dry toilets that can be found are the chemical toilet and the eco-san toilets. There is controversy over the suitability of some of the pit latrines and dry toilets in providing adequate and safe services. The simple pit latrine is thought to be cheap to maintain (both at municipal and at household level) and thus suitable for low income households (Aqua Consult, 2003). However experience shows that they are not necessarily more affordable in practice (KCC, 2003). Inadequate management practices particularly with respect to emptying and maintenance have resulted in low operational life of the latrines (KCC, 2003). In a study in Kampala, Katukiza *et al.* (2010) found that the user to facility ratio of shared latrines in an informal settlement ranged between 1:30 and 1:70, well above the Uganda Ministry of Health recommendation of 1:20 and would therefore require frequent emptying. Moreover, the high housing densities in informal settlements means that access for construction and for operational activities is a challenge (Majale, 2002). For example, over 78% of the households in the 220 informal settlements in Cape Town are inaccessible by trucks (Mels *et al.*, 2008). Experience also shows that simple pit latrines and chemical toilets could be an environmental and health hazard in humid environments, or if they are poorly constructed in areas with a high water table (Tissington *et al.*, 2008; KCC, 2003).

Social acceptance of the choice of technology or management option is key to the success of water and sanitation interventions. A study in Kampala found that residents of informal settlements required a different approach to service delivery than that followed in the planned sections of the city, e.g. the majority of the residents that were surveyed earn a daily income (in the informal sector) and preferred to pay their water bills daily in a manner that matched their income pattern (Aqua Consult, 2003). The study also found that the institutional arrangements with respect to billing, response to customer complaints and applications to connect to the system did not frequently match the expectations of the customers (Aqua Consult, 2003). Inadequate stakeholder involvement prior to the

introduction of a new technology or change in management has been cited as the cause of conflict between service providers and their customers (see Bond & Dugard, 2007: Anti-Privatisation Forum, 2006). Selected examples of public response to technological intervention are discussed inBox 2-2.

2.2.2 Institutional challenges

2.2.2.1 The politics of service delivery

The public interest nature of water and sanitation essentially makes the management of water services a political issue (van der Zaag & Savenije, 2006). In the 1980s, the governments of developed countries started to question the efficiency of state-led utilities in service delivery and began to privatise water entities. Privatisation was seen as a means of introducing competition and thus increasing efficiency of operations. The water companies were often time able to raise additional capital for much needed investment in expansion and maintenance activities (Mader, 2011). Development partners and financing bodies encouraged developing countries to embrace privatisation as part of the policy reforms to improve service delivery, and in some countries even attached this as a condition to access financing (Hemson *et al.,* 2008.)

Box 2-2: Selected examples of public response to choice of technology

The use of pre-paid meters in Johannesburg and Kampala

In 2003, as a demand management strategy, and in a bid to improve cost recovery, the City of Johannesburg launched an initiative to implement pre-paid meters in Phiri, Soweto (Anti-Privatisation Forum, 2006). This initiative sparked heavy protests from some of the residents who felt that they had not been consulted; and from lobby groups who argued that the pre-pay system would violate the residents' right to water supply, especially since the pre-paid meters automatically cut off supply when credit has run out. The conflict was only resolved after a lengthy court battle that reached the Supreme and Constitutional Courts (Constitutional Court of South Africa, 2009). The Constitutional Court of South Africa overturned the High Court and Supreme Court ruling that the pre-paid meters and the manner in which they were installed were unreasonable and unlawful. Moreover, by the time of the Constitutional court ruling, the benefits of the pre-pay metering system could be seen: unaccounted for water had reduces, and extensive community consultation had also increased social acceptance of the technology.

In Kampala, pre-paid meters were installed as an effort to eliminate water vending and thus ensure that the poor get access to water at the subsidised stand pipe tariff. The National Water and Sewerage Corporation of Uganda initiated the new technology as a pilot project and installed the pre-paid meters on communal taps in selected informal settlements in Kampala (GKW Consult *et al.,* 2003). Berg & Mugisha (2009) evaluated the financial and social benefits of the pilot project, and found that the right combination of level of service intervention (i.e. yard tap and an optimised number of communal stand pipe with prepaid metres) could result in substantial financial and social benefits. The users of the pre-paid technology affirmed that accessibility to water supply had improved (access to the taps was previously restricted to the working hours of the vendors) and affordability had increased as a result of the direct billing afforded by the meters.

Prior to the privatisation policies, governments had largely subsidized water services, and as the government subsidies reduced between 1990 and 1998, the water companies passed their costs on to the users through increased tariffs. Affordability decreased and the companies started to institute mechanisms to enforce revenue collection and penalties for non-payment. The poor were the worst affected by such policies (Hemson *et al.*, 2008). In Argentina, tariffs were reported to have increased by up to 60% among the lowest income bracket (Holland, 2005). The high tariffs led to high rates of non-payment and an increase in water related illnesses as the poor switched to alternative, and sometimes contaminated sources (Holland, 2005). There was also resistance to the tariff increases, both by the governments (e.g. in the Philippines and in Argentina) and by the consumers (e.g. in Bolivia) (Moss *et al.*, 2003). The companies were incapacitated to provide quality services, which resulted in low willingness to pay (WTP). Many private companies (e.g. in Argentina, Bolivia, Guinea, Mozambique, and Zimbabwe) either did not re-new their contracts or terminated the existing contracts (Holland, 2005; Moss *et al.*, 2003; Schultz, 2000). The private companies (e.g. in Cochabamba, Bolivia) also faced the challenge of balancing the objectives to maintain efficiency and profitability while ensuring equity. It costs more to provide services to the poor, by virtue of their location (informal settlements are usually located in areas of difficult terrain and low accessibility, they are usually very poorly served and so have a higher marginal cost of extending services) (UN Habitat, 2010). As a result, many private companies did not have the incentive to expand services to areas that would not contribute to their bottom line (Holland, 2005).

Studies show that although user charges are effective as a cost recovery mechanism among the higher income population that live in formal neighbourhoods, they are not adequate when extended to the poor. One of the common penalties for non-payment of water bills is to disconnect the defaulting households from access to the service (MacDonald, 2002). Poor households that cannot afford to pay are thus disconnected from the service and then subjected to further costs (the reconnection costs) that are required to gain access to the service again (Anti Privatisation Forum, 2008; McDonald, 2002; Alence, 2002). Furthermore, the execution of cost recovery penalties such as cut-offs and pressure restrictions have opened debate on the role of private companies in the supply of a basic service and the potential violation of the human right to water (van der Zaag & Savenije, 2006; MacDonald, 2002). In some countries (e.g. the UK), it has since been made illegal to use cutting off water supply as a cost recovery mechanism, although many developing countries still maintain the practice(MacDonald, 2002). The privatisation model has generally not been able to address the needs of the poor because the revenue generation mechanism that is applied (i.e. the user-pays principle) is inadequate where a large portion of the population is unable to pay (Mader, 2011; MacDonald, 2002).

2.2.2.2 Inadequate institutional capacity

In many African countries, local governments are responsible for provision of services in informal settlements. The local governments are however showing a slow response to meeting the service delivery needs of the urban poor (Majale, 2002). One of the challenges is

the lack of institutional capacity to manage the financial and technical components of the investment projects (UN-Water/Africa, 2006). Some of the reasons for the poor performance of the local governments are rigid and bureaucratic administrative structures that are slow to respond when required (Otiso, 2003), misallocation of resources due to corruption (Otiso, 2003), weak regulation and management of service contracts (Goldberg *et al.*, 2009), and lack of adequate human capital (Tissington *et al.*, 2006), among others. Poor regulatory and policy guidelines result in informality as private actors fill in the gaps caused by poor supervision and oversight (Goldberg *et al.*, 2009). Municipalities in South Africa have expressed concerns over the inability to attract and retain the human resources necessary to manage services, and depend on outsourcing to carry out operational activities in informal settlement's which, in the absence of knowledge transfer, further exacerbates the human resource shortage (Goldberg *et al.*, 2009; Tissington *et al.*, 2006).

WSP (2009) recommends strengthening institutional capacity to serve the poor and developing appropriate financing mechanisms that would give institutions incentive to serve the poor. Several initiatives have been implemented to improve access to water services in informal settlements in Africa. For example, Ghana, South Africa, and Tanzania provide free basic water to the public, while Senegal and Uganda provide subsidised water connections to low-income communities through social connection programs (World Bank, 2008). These social connection programs involve substantial reduction, and in some cases elimination of connection fees which would otherwise be a barrier to access to the water and sewer networks (WSP, 2004). Otiso (2003) looked at the role of the public sector, private sector and voluntary organisations in improving services in informal settlements in Kenya, and found that the three actors possessed complementary qualities that had the potential to improve the effectiveness of service delivery in informal settlements. The strong capacity of the public sector to raise financial resources, coupled with the management capability in the private sector and the ability of voluntary organisations to operate at grassroots level and effectively communicate with communities indicates potential to create an institutional framework that captures the strengths of the public, private and voluntary organisations in a manner that improves services in informal settlements.

2.2.3 Financing challenges

Water infrastructure has traditionally been financed using a combination of public funds, user charges (tariffs) and Official Development Assistance (ODA). Analysis of the water sector shows that the poor performance with regard to expansion and operation and maintenance is contributed by among others, poor financing and cost recovery. This can be attributed to the poor design of subsidies and to low fiscal allocations which leave municipalities with large backlogs in investment and maintenance (UN-Water/Africa, 2006).

Cost recovery is a crucial revenue-generating mechanism necessary for provision of quality services. The costs of providing urban water services normally include the cost of building the infrastructure, cost of operation and maintenance of the infrastructure, and the management costs associated with delivering the service. These costs may be analysed in three elemental categories, as summarised in OECD (2009):

- The financial costs, comprising of the capital, operations and maintenance costs.
- The economic costs, which include the financial costs, the opportunity costs and the economic externalities.
- The full costs, which include the financial costs, the opportunity costs and all externalities (economic, social and environmental). The full costs could also be expanded to include public administration (regulation and institutional) costs of providing the services and water resource management costs (Cardonne & Fonseca, 2003; Rogers *et al.,* 1998).

Studies have found that the potential for full cost recovery and revenue generation exists, but can only be achieved through cross subsidization in which only part of the costs are recovered from the users (through tariffs) and the rest are covered by public transfers (OECD, 2009). This section discusses some of the options available for financing services in informal settlements.

2.2.3.1 Water pricing – tariffs

Water pricing through tariffs is a useful cost recovery instrument because of the direct link it provides with the users (Alence, 2002). Private connections are expected to make a higher contribution to cost recovery because they are metered, have better customer identification, and cost recovery mechanisms such as penalties for non-payment can be executed much more easily than for other sectors (Alence, 2002). The aim of any water pricing strategy is to balance the cost of investment with the revenue collected for operation, maintenance and/or loan amortization, and will depend on the cost of production, the level of government subsidy, and affordability among the consumers (OECD 2010). In line with the Dublin statements (ICWE, 1992), the pricing structure should also communicate the scarce nature of the resource and promote efficient use while still maintaining equity and affordability among users. Due to affordability concerns, the tariffs in many African cities are not designed to recover the full cost of service provision, and as a result, these cities rely heavily on financial support from central governments (WPP & AfDB, 2010). For example, in Uganda it was reported that institution of a tariff that includes debt servicing (with respect to capital costs) would reduce affordability levels (Muhairwe, 2007). In the absence of adequate supplementary finance from government, implementation of partial cost recovery can be ineffective, leading to underinvestment in maintenance and delayed capital investments. Setting low tariffs also hinders revenue generation required to extend services to the poor (OECD, 2009).Since informal settlements are normally located in areas with low accessibility to the network, cross subsidies do not get to the poor (who are not connected to the network) and therefore benefit largely the (richer) households already within reach of the distribution network (Mosdell, 2006; McDonald, 2002; Alence, 2002; Walker *et al.,* 2000; Mycoo, 1996). While it is recognised that full cost recovery may not always be possible (where affordability among users is low), it is recommended that African cities adopt a gradual process towards cost recovery through use of appropriate service levels for which the users are willing to pay.

In the recent past, there have been strong calls for the inclusion of stakeholder participation in policy planning and the promotion of demand-responsive investments that match policy with user affordability and willingness to pay (OECD, 2009; Serageldin, 1994). Willingness to pay (WTP) surveys are useful tools for identifying consumer affordability and acceptability of price and policy changes. WTP surveys are also able to measure perceptions for social and welfare objectives (Raucher *et al.*, 2005). The key questions then are: whether collective affordability (among the society) are adequate to meet the needs of those who cannot afford to pay the costs; whether the beneficiaries that can afford are willing to pay for those that cannot afford to pay; what trade-offs would affect their willingness to pay; and what cost recovery mechanism would be most appropriate.

2.2.3.2 The role and impact of subsidies

Subsidies are a means through which governments re-distribute public funds for purposes of meeting economic and social objectives. In the case of water services with large public benefits and where affordability issues are a concern, governments normally aim to keep end-user prices low – either by reducing production costs of the utility; by reducing the price of connection to the network; or by reducing the consumption fees (WSP, 2009). This can be implemented: through budgetary transfers; through tax exemptions; or through preferential interest rates on borrowed funds (OECD, 2009).

Given the cross-cutting and multiplier benefits involved, there are grounds for increasing the public budget allocation to the water sector to accelerate expansion of services to the population that are not served (UN-Habitat, 2011; OECD, 2009). Subsidies generally finance the provision of services to the population that cannot pay by using funds from those that can afford to pay, and thus the true costs are not reflected, i.e. the true opportunity cost that would prevail if all externalities (costs and benefits) were internalized or the true production costs of getting the services to people (Mitchell *et al.*, 2007). If not adequately instituted, subsidies can become a burden to the water utilities, e.g. there is a risk of financial imbalance in areas that have a large poor population that needs to be subsidized compared to the paying population (Blanc, 2007). For example, municipalities and water authorities in South Africa have expressed concern over the financial sustainability of providing free basic services, especially in cases where the tariff structure does not result in adequate funds to cover the costs of the population that cannot pay for services (Bond & Dugard, 2008). Two questions thus arise: the determination of the amounts that the "non-poor" are willing to pay and the identification of the means through which this payment can be collected and effectively targeted towards the poor.

2.2.3.3 The role of the private sector

The role of the private sector and their application of the "user pays" principle as a cost recovery technique in the management of urban water services has been a topic of international debate since the 2000s (van der Zaag & Savenije, 2006; Moss *et al.*, 2003). Researchers have pointed out that water use has a high societal relevance and some users

have a very limited ability to pay for it; indicating that water is a public good whose allocation should be a societal question, and for which governments are responsible to ensure accessibility to all (Muller, 2008; van der Zaag & Savenije, 2006). In the private sector participation model, the role of government is structured to perform a regulatory and financing function while management of the assets and service delivery is contracted to the private sector (Briscoe, 1998). Since 2002, international funding agencies have steadily reduced financial commitments towards water services (Hemson *et al.,* 2008) leaving the challenge to national governments to raise the investment and maintenance requirements of the local governments. The Bonn Conference of 2001 (ICFW, 2001) made several recommendations aimed at strengthening public finance and targeting investments to the poor, e.g. tapping into capital markets, and implementing cost efficient management tools (Winpenny, 2003).

Developing countries have to overcome the challenges associated with accessing private finance. High capital costs and long payback periods will make countries which have a low investment rating unattractive for private financing. Furthermore, the exchange rate risks involved with borrowing money in a foreign currency and paying back with revenues collected in a local currency make for unfavourable borrowing conditions (OECD, 2009; Hemson *et al.,* 2008). Public institutions need to improve their capacity to increase own-revenue, as this improves the financial sustainability of the water utility, improves creditworthiness, thus increasing access to private finance (OECD, 2011b; UN Water Africa, 2006). This may well make the case for valuation of all benefits, not just from the users, but also from other members of society who benefit from the urban water service offered to others, i.e. the non-users (Harpman *et al.*, 1994).

2.2.3.4 Financing for the future

The cost of maintaining existing infrastructure is growing, and it is expected that this will soon surpass the cost of network expansion (OECD, 2009). It is estimated that 54 billion USD is required globally to operate and maintain the current infrastructure (OECD, 2009). It is therefore important for any financial planning to consider the need for increased expenditure in O&M, and thus include strategies to either save on current expenditure and/or increase revenue (OECD, 2009).

Increasing operational efficiencies could be a useful tool in reducing costs and thus postponing financing needs. For example, high levels of unaccounted-for-water mean that more water needs to be produced in order to deliver the required amount of water to users. Reducing unaccounted-for-water would thus also postpone the need for investment in increasing production capacity. Furthermore, improving efficiencies in the areas which interface with customers such as revenue collection or response to leaks and complaints would potentially improve customer willingness to pay (Raucher *et al.,* 2005).

The choice of level of service can have a big impact on costs. Assessment of the lifecycle costs of a different level of service prior to implementation would greatly influence the choice of level of technology by both the service provider and the consumer

(Mitchell *et al.,* 2007). Hutton & Bartram (2008) find that high technology solutions can cost more than twice that of a low technology solution. Implementation of low technology solutions that allow for upgrade as needs and affordability levels change would reduce the high initial capital costs required to increase coverage (Parikh, 2008).

Water policies should also be cognisant of the vulnerability of dependence on the public sector (government budget) for financing sector activities, particularly for countries under resource constraints (OECD, 2009). This requires utility companies to strengthen their revenue base, essentially through user charges, in order to improve their creditworthiness for private finance (UN Habitat, 2011; OECD, 2009). User charges can be designed to meet all the financial and economic costs of providing the service (full cost recovery) or they can be designed to meet all financial and economic costs and externalities (sustainable cost recovery) (OECD, 2009; Mitchell *et al.,* 2007). Many cities however are not able to recover the full cost of service delivery, and thus set a minimum practical expectation that user charges should at least meet in terms of operations and maintenance (O&M) and sometimes depreciation costs. Where full cost recovery cannot be initially guaranteed (due to affordability constraints), a gradual process could be followed in which the user charges cover the O&M costs and are increased gradually (with increase in economic wealth) to cover depreciation costs, capital costs and eventually full cost and sustainable cost recovery (WPP & AfDB, 2010; OECD, 2009). OECD countries have seen an increase in prices for water services over the years, indicating that there may be potential for developing countries to increase the role of user charges in cost recovery, and in meeting the social and equity concerns of society (OECD, 2009).

The past 40 years of dialogue on the policy and practice of providing water and sanitation provide a few lessons that are relevant to policy makers and professionals in the service delivery sector:

i. The key aim of policy should be to balance the allocation of water among all its competing uses. This requires an integrated approach to the management of water services.

ii. Policy formulation should be driven by stakeholder consultation and backed by political will.

iii. Water policy should be considerate of the impacts of climate change, water scarcity and population growth, and should incorporate environmental and social externalities.

iv. Cost recovery is key to financing policies. Cost recovery attempts should however take into consideration affordability among users in order to maintain accessibility to the poor. Municipalities in developing countries have to find the balance required providing services where, on one hand the majority of the poor population cannot afford the basic level of service and, on the other hand, failure to raise revenues leads to deterioration of the infrastructure and the quality of service. Institutional and financing solutions should be designed to suit the local socio-economic, political and cultural contexts of the communities.

2.3 The value of water services

"The totality of human endeavour is directed at securing the highest possible level of welfare and comfort for man" (Emmanuel, 1994).

Historically, the first definitions of value related to (i) intrinsic value (i.e. the value that a good holds in itself) and (ii) value with respect to usefulness (i.e. the value in use or as a means of exchange) (Hanemann, 2005). Later definitions shifted to focus more on people's subjective preferences rather than objective human need or usefulness. Consequently, modern economists describe value in terms of the satisfaction or utility derived from using a resource, as evidenced by willingness to pay to obtain (WTP) or willingness to accept compensation to forego (WTA) the benefits (Raucher *et al.,* 2005). As described in Hanemann (2005), there are three principles that are important for a proper understanding of the concept of value in the urban water context:

- The cost of water, which reflects the cost of treating and distributing water supply (Hanemann, 2005), described as: the supply costs which include the capital costs (associated with depreciation and interest on investment) and the O&M costs (costs associated with running the system, such as raw water purchase, electricity costs, labour costs, production and storage costs, etc.); the economic costs, which include the supply costs plus the opportunity cost (associated with the cost of alternative uses of the water resource) and economic externalities (costs imposed on third parties due to the use of the resource); and the full costs, which include the economic costs plus environmental externalities (costs associated with public health and ecosystem use) (Rogers *et al.,* 1998).
- The price of water is set by utility companies and reflects the marginal cost of providing water to the next customer. Most utilities meet their financial costs through tariffs, which are usually designed to: cover O&M and in some cases, debt servicing costs (Raucher *et al.,* 2005). It should be noted that the price of water, as set by the utility companies, is not always a true reflection of the cost or the value of water. As explained in Section 2.2.3.2, in order to ensure affordability, the end-user price of access to water services is sometimes subsidized either through public subsidies or through development aid.
- The value of water, which is a reflection of an individuals' preference. Value depends on the desirability or need for the service, and can be measured by assessments of willingness to pay for access (Raucher *et al.*, 2005).The trade-off that an individual is willing to make in exchange for the service is a measure of its value. It should be noted that willingness to pay is distinct from affordability or ability to pay. Studies have found although the poor express a high willingness to pay for water services, they cannot afford to pay (Wang *et al,* 2008; Nam & Son, 2004). For example, sensitivity tests reveal that the demand for water services is dependent on the household expenditure, and will decrease if the price is increased. In China, Wang *et al* (2008) found that although the willingness to pay among the poor was 3.3 times higher than the average, about 20% of the low income households would strongly reject a 40% price increase. Yang *et al* (2006),

Pattanayak *et al* (2006), and Gulyani *et al* (2005) also found that the poorer households in Sri Lanka and in Kenya had lower ability to pay for a level of service upgrade. In order to recognise that willingness to pay should be backed by capacity to pay, development agencies have adopted a benchmark of 3 to 5% of household income as an indicator of affordability for water services (World Bank, 2002).

This section discusses the literature on valuation of goods and services. The typologies of total economic value that are commonly used in the environmental and transportation literature are also discussed, including a proposal of an appropriate adaptation of the value typology to suit the context of the urban water sector.

2.3.1 Value perspectives of urban water and sanitation services

Water as a natural resource has, throughout history, always had value. In the past, many societies attached an intrinsic value (the value that some goods possess in themselves) to water. For example, the Egyptians, Greeks and Minoans attached spiritual value, believing water to be holy (Juuti *et al.,* 2007); later, the Romans attached monetary value and charged for water consumption (Juuti *et al.,* 2007); and African societies attach cultural value to water (UN-Water/Africa, 2006).

Modern society concerns itself with more than just the intrinsic value, and requires that issues relating to fresh water availability, poverty reduction and the management and allocation of water are given due importance by all stakeholders (Moss *et al.,* 2003; Bosch *et al.,* 2006).Understanding the value of water in the urban water context requires an understanding of the different functions of the urban water system as discussed below:

i. The environmental function of UWSS which aims to avoid depletion of the resource requires that water abstractions from the system should be lower than the available resource and that the quality of the resource should be maintained for future or downstream users. Environmental value could be derived through the benefits of healthy ecosystems and all that depend on them, i.e. species, recreation and tourism.

ii. The economic function which acknowledges that there are competing uses of water and attempts to ensure equitable and sustainable allocation between the different users (i.e. high value uses should be given high priority).The economic value describes the overall worth of the good or service and involves assessment of benefits (perceived or real) that are associated with the service. The economic value of water can be derived through value gained in production and product use, e.g. in water-dependent industries and agriculture, or through concerns for efficiency in allocation between the different functions of the urban water system.

iii. The financial component of UWSS that recognises the need to generate funds to develop and operate the assets required to deliver the services; comprising of the capital cost and the operation and maintenance cost of accessing water supply and treatment and disposal of wastewater. Financial value is expressed through concerns for operational efficiency,

and applies costs (expense to produce the service) to determine the price (amount charged for the service). In the water sector, for example, the true value of the water service need not be (and usually is not) equal to what the utility company charges.

iv. The social component of UWSS that reflects the costs and benefits that are borne by society but may not be accounted for in the production of the services, e.g. the effects of a breakdown of services on public health and the cost of provision of services to the sections of society that cannot afford to pay for them. Societal concerns for affordability are normally financed either through cross-subsidies (from the rich to the poor) or through direct subsidies (from national government).

v. The role of the water system in maintaining public health is expressed as the burden of disease and is evidenced through the public sector and household expenditure on treatment of water-related disease.

vi. The urban water system also plays a gender supporting role in society. In the absence of adequate water and sanitation, women and children spend a lot of time fetching water, time that could otherwise be spent on income-generating activities or in school.

There is evidence that links the growth of urban water services to society's recognition of these value perspectives, e.g. the extension of water services to poor communities in Britain was in response to public health interest following the cholera epidemics in the 1840s (Hemson *et al.,* 2008). Similarly in 19th century Sweden, public health benefits were used to convince policy makers to extend the water supply network to poor communities outside the administrative borders of the cities. For example in the city of Norrköping, residents were concerned that the unsanitary conditions of the neighbouring poor community could pose a health risk. Insurance companies also pressed for extension of the network for fire fighting purposes. The public benefits realised included increased property value due to higher levels of service, reduced risk of damage to life and property, and lower insurance premiums (Nilsson, 2003). In 19th century USA, sewer services were only provided to richer households and wastewater was discharged untreated into the environment. The expansion of the network and treatment of the sewage were only implemented after the involvement of municipalities. The municipalities were able to secure federal government subsidies on the basis of the impact that negative externalities had on downstream water users. In order to ensure public health benefits, measures were also put in place to regulate pollution of the water courses, *viz* the 1948 Water Pollution Control Act (Hemson *et al.,* 2008).

2.3.2 Valuation of urban water services

Policy decisions always have a cost implication, usually measured through an economic valuation or an analysis of the cost effectiveness of policy outcomes (WHO, 2012). The benefits of water services can vary in terms of impact (can be individual or public benefits) and depending on the technology and the level of service received (determined primarily by the affordability levels of the users). One of the benefits of the collective provision of water

services is to utilise economies of scale to internalise the costs of providing the different levels of service (van der Zaag & Savenije, 2006). Another reason for the collective provision of these services is the incorporation of social objectives (e.g. equity and affordability concerns) or by maximising public benefits, a task best provided collectively by the municipalities as representatives of national government (van der Zaag & Savenije, 2006).

There are concerns that unless the actual cost of access to water is made clear, the true value of water will always remain low, resulting in persistent under-funding of water and sanitation investments and a failure to meet the water-related MDGs (UN Water Africa, 2006; Moss *et al.,* 2003). There are several reasons why urban water services are generally not valued: the perceptions of water-related issues are ever-changing, for example the perceptions of water change with water scarcity, socio-economic conditions, etc. (Moss *et al.,* 2003); there seems to be a lack of consensus on valuation methodologies (Raucher *et al.,* 2005); and in some cities, there is inadequate dialogue between the decision makers and society on what value perspectives are of importance, as evidenced by civil contestation on service delivery (Allan & Heese, 2009; Raucher *et al.,* 2005; Moss *et al.,* 2003). The process of economic valuation could provide a potential solution to this service delivery gap by promoting stakeholder participation in the decision-making process (Moss *et al.,* 2003).

2.3.2.1 The concept and definition of value

According to the environmental literature, the Total Economic Value (TEV) of a resource is described as the total benefit that an individual derives from its use or availability (Young, 2005; Gardner Pinfold Consulting Economists *et al.,* 2002). In a market scenario, the value of goods is based on the price of producing an additional unit of the good (i.e. the marginal price). The value of a private good is thus evidenced by its market price. Research has found that market valuation approaches underestimate the total economic value of public goods and services (Gardner Pinfold Consulting Economists *et al*, 2002). Firstly, the marginal price of accessing a public service cannot be readily determined, and secondly the benefits of accessing a public service are not restricted to the person that pays for the service (van der Zaag & Savenije, 2006).Economists determine the value of public services through expressions of willingness to pay or willingness to accept compensation to forego the benefits of using the service. The trade-off that an individual is willing to make in exchange for the service is a measure of its value (Raucher *et al.,* 2005).

Traditionally, researchers and planners were only concerned with use values (i.e. values derived from consumption of the resource). In the 1900s however, environmental economists researching the preservation of natural habitats began to explore the idea that individuals who do not use a resource and that do not intend to use the resource in the future could experience a reduction in utility if it were not available (Turner, 1999). This was the first attempt at identifying non-use value. Weisbrod (1964) and Krutilla (1967) formally introduced the concept of non-use value and attempted to explain it in the context of economic theory. They noted that individuals who may never visit or use a natural resource can be affected by

changes in its status and would therefore be willing to pay to maintain or improve its status. Weisbrod (1964) introduced the notion that individuals may have a desire to retain a natural resource (e.g. retention of a national park) for the option of future visits, and as such exclusion of possible future users from benefit studies may not provide results that represent all of the benefits of the resource (Weisbrod, 1964). The option value is defined in some literature as a use value, based on the definition of use values as values related to the utilization of the resource (Humphreys, 2003; Rogers et al., 1998). Krutilla (1967) supplemented the notion of non-use value, explaining that individuals may derive satisfaction from the knowledge that a natural resource exists, even if they have no intention of visiting the site (existence value). He also described another scenario in which an individual has the desire to preserve a resource for the enjoyment of future generations (bequest value). Subsequent work has expanded the description of bequest value to include the value derived from use of the resource by other persons of the current generation (i.e. altruistic or philanthropic value) (Mitchell & Carson, 1989). It is now widely acknowledged that environmental resources and transportation systems may possess non-use or passive benefits that may be of value to members of society regardless of the fact that they do not use them (Laird, 2009; Humphreys, 2003; Crowards, 1995). A comparison of the selected value typologies from the transportation and environmental literature is shown in Table 2-4.

Table 2-4: Comparison of different typologies of value

	Pearce & Özdemiroglu (2002)	**Turner (2002)**	**Gardner Pinfold……*et al.*(2002)**	**Rogers *et al.* (1998)**	**Crowards (1995)**	**Humphreys (2003)**
Use	Direct use. Indirect use. Option to use (self, others or future generation).	Direct use. Indirect use. Option to use. Bequest (current generation).	Direct use. Indirect use. Option use.	Value to users of water.	Use value. Option value.	Direct use.
Non-use	Existence.	Quasi-option. Bequest (future generation). Existence. Intrinsic. Primary value.	Bequest. Existence.	Indirect uses. Environment. Societal. Intrinsic value.	Quasi option. Bequest. Existence. Philanthropic.	Non users. Option use. Indirect use. Existence/ altruistic.

2.3.2.2 Typology of value for urban water services

The need to ensure sustainable water resource management – i.e. to balance the different societal uses of water (e.g. water supply to the poor), to balance the high and low value uses and to balance the present and future demands – is one of the primary drivers for the economic valuation of water services (Raucher *et al.* 2005). In order to enable comprehensive policy analyses and comparative studies, it is important that the definitions and components

of total economic value are standardised (Crowards, 1995; Smith, 1987). An exploration of the components of value, applied in the context of urban water services is summarised below:

Use Values are associated with the tangible utilisation of the resource.

- *Direct Use values* are derived from actual use of the resource and comprise consumptive use which pertains to the value that is associated with consumption or extraction of the resource (e.g. water used for agricultural, industrial and municipal purposes), and non-consumptive use values which pertain to the value that is derived from use but not consumption nor extraction of the resource (e.g. use of water for recreation, for hydropower and for navigation). In some literature, non-consumptive use values are described as indirect use values (Gardner Pinfold Consulting Economists *et al.*, 2002). Direct use values, since they relate to consumption and water use behaviour, are usually paid for in terms of tariffs. The value of the service is commonly inferred by interpreting the changes in the amount that people are willing to pay over and above what they currently pay (Raucher *et al.*, 2005). Studies show that the willingness to pay value changes with different uses of water, e.g. elasticity of demand studies have found that increasing the price of water used for basic needs such as cooking and hygiene will not change the demand, whereas increasing the price for less fundamental uses such as gardening will result in a reduction in willingness to pay (Raucher *et al.*, 2005; Rogers *et al.*, 1998).
- *Option values* arise where an individual may be willing to pay for the option of using the resource at a time in the future. The individual is willing to pay to have the resource available, whether or not they use it in the future. Examples are the willingness to pay in support of a national park for the option of visiting it in the future, or value associated with recreation, scenic quality or property value (Bateman & Langford, 1997). In the transportation sector, option value is defined as *"the utility that an individual derives from the continued availability of a particular mode, or the additional transport service characteristics that it represents, within their choice set of potential modes"* (Humphreys, 2003). It is seen as a risk premium that some members of society are willing to pay to have the option of using some part of the transport system (e.g. use of public transport in the event that their private car breaks down) (Laird *et al.*, 2009) or the willingness to pay to retain substitute routes in a road network to maintain the option of using these routes. In urban water supply, option value could manifest as the willingness to pay to maintain certain levels of service, to allow for the possibility of downgrading; for example from a high pressure high quantity level providing 1000 litres per day to a level providing 750 litres per day, or willingness to pay for extra storage capacity and fire demand within the water distributing network.

Non-Use Value is a value that arises independent of use or consumption of the resource.

- *Indirect use values* arise as a result of an individual realizing utility without coming into contact with the resource. Humphreys (2003) explains the notion of vicarious and functional indirect benefits. Vicarious utility is the satisfaction derived from the use or consumption of a good by another (known or related) person (likened to vicarious pleasure or intra-generational altruism). Practical examples of such vicarious benefits include reduced risk of disease outbreaks, improved efficiency of a healthy labour force, savings on medical payments / insurance for staff, lower social and health sector costs, etc. Functional utility is said to result from an indirect relationship between the donor and the good, with respect to the functioning of the good as opposed to its consumption (Humphreys, 2003). Practical examples include willingness of private car users to pay towards maintaining a public transportation system in order to avoid congestion. Adapting this description to the urban water sector, functional indirect benefits could be realized through individuals' willingness to pay to have the city fully serviced with water and sanitation to avoid the disutility caused by environmental pollution, or disutility caused by the social unrest that often follows a break-down in service delivery.
- *Passive value* comprises of bequest and existence value. Bequest value arises from the desire to pass on a resource to future generations. Examples include values associated with preservation of culture, species or habitat. Some of the literature includes bequest benefits as a use value that relates to the benefits that an individual gets from having people of future generations use the resource. These are also expressed as altruistic or philanthropic gestures, e.g. use of donations to express the value of an environmental resource or wildlife (Champ *et al.,* 1997). Existence value results from individuals realizing utility from the knowledge that a resource exists. Existence values are derived when individuals are willing to pay to have a resource available, even if they have no intention of using the resource. An example could be willingness to pay for preservation of an endangered species, or to preserve a natural habitat, or willingness to pay to preserve an obsolete railway line that is of no use, for purposes of preserving history (Humphreys, 2003).

The typology discussed above is illustrated in Figure 2-2.

2.4 The economic valuation of non-use benefits

Water links us to our neighbour in a way more profound and complex than any other (Thorson n,d).

Economists have argued that the exclusion of non-user benefits in value assessments leads to an under-estimation of the total value of resources (Harpman *et al.,* 1994; Bristow *et al.,* 1991). Krutilla (1967) makes the case for valuation of non-user benefits by arguing that there are values for which markets fail to account and the absence of market values does not exclude the existence of value, e.g. in the case of public goods. Carson *et al.* (1999) recommend that, for such cases, value can be derived through indirect methods such as observations of related behaviour or through creation of "markets" in a simulation of market transactions.

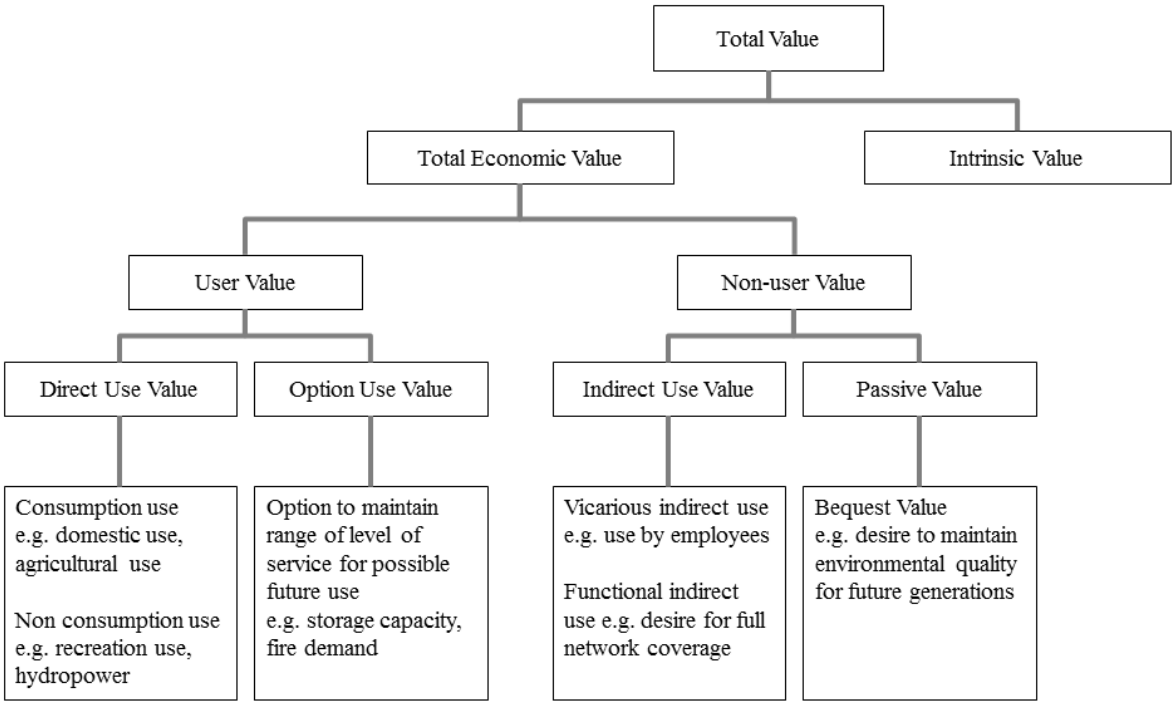

Figure 2-2: Typology of value in urban water services
(Gardner Pinfold Consulting Economists *et al.*, 2002)

There are arguments that the different components of Total Economic Value (TEV) are irrelevant to the valuation process. On the one hand, some researchers (Aldred, 1994) argue that the only non-use values are intrinsic values, and all other "non-use" values (i.e. existence and bequest value, as illustrated in the preceding section) are based on the use by someone else. Furthermore, the identification of non-use benefits on the basis of motives is also a matter of debate since current economic theory does not support the valuation of motives (Weikard, 2002; Carson *et al.*, 1999 in Crowards, 1995). On the other hand, other researchers affirm that when faced with a choice of different goods or services, individuals place value based on their perceived benefits, and make a trade-off based on the combination of characteristics of the good or service that gives them maximum benefit (Hensher *et al.*, 2005). Measurement of individual value for an environmental resource therefore does not measure the motive, but the value of the combination of characteristics that provides the individual with maximum utility. Furthermore, they state that as long as individual choices result in utility maximizing behaviour or in economic benefit, they can be valued through evaluation of personal preferences (Lancaster, 1966). This is further supported by Crowards (1995) and Aldred (1994) in which the definition and measurement of non-use values is shown to be consistent with the derivation of utility functions based on personal preferences, using revealed or stated preference methods to derive willingness to pay. It is however possible that an individual values a resource solely for the benefit of others (on purely ethical, moral or selfless grounds). Such altruistic motives, which do not result in any increase in welfare of the individual, if they exist, would render inaccurate the economic valuations based on utility maximization theory (Edwards, 1992).

This section discusses the theory and application of some of these stated preference techniques, in particular the design and analysis of multi-attribute valuation methods. Further discussions can be found in Gutanilake *et al.* (2007), Louviere *et al.* (2000), Stevens *et al.* (2000) and Adamowicz *et al.* (1994).

2.4.1 Motives, information and non-use value

Economic valuation is based on the theory that individuals realize utility for a good or service and thus, irrespective of their motives, place a value on that good or service. The issue of motives, altruism and their inclusion in economic models is widely debated. Researchers question whether individuals can be truly altruistic; whether their choices are ultimately based on self-interest or whether there are vicarious benefits to seemingly "altruistic" actions (Turner, 1999; Crowards, 1995). Non-use benefits, by definition, do not accrue to the individual and so there is no direct link between the non-use values and the tangible benefits of the resource. Pearce & Özdemiroglu (2002) and Randall (1986) suppose that all non-use values must therefore fall under some form of altruism since the benefits are independent of current or future use. Crowards (1995) outlines possible scenarios where altruistic behaviour could manifest:

i. Where the individual receives satisfaction in giving to others, satisfaction from the concern for others maximises the individual's welfare.
ii. Where the individual makes choices, not based on altruistic motives towards others, but where they foresee benefit in the long term.
iii. Where the individual receives no satisfaction in giving to others. This possibility is derived where there are moral considerations.

Champ *et al.* (1997) and Crowards (1995) state that altruistic values, as long as they are based on satisfaction of individual preferences, can be said to satisfy utility maximizing behaviour and thus can be explained using the commonly used economic models. However, Turner (1999) presents a scenario that could oppose the application of utility maximisation theory to the valuation of non-user benefits, supposing that an individual could value a resource purely for the benefit of others (e.g. a low willingness to accept compensation for loss of a unique environmental resource). If such motivations are independent of any self-interest, the individual's choice could result in a reduction in welfare (Turner, 1999). Rogers *et al.* (1998) assert that the concept of economic value "*.....does not assign any value to concerns such as stewardship, bequest values, and pure existence values.*" They categorise the benefits as current (direct and indirect) user benefits and intrinsic benefits (external to the use of the resource), and recommend the use of surveys to identify and isolate motives and intrinsic benefits.

Some researchers believe that the motivations behind willingness to pay values can be deconstructed during implementation of the survey (Humphreys, 2003; Rogers *et al.*, 1998). On the other hand, other researchers believe that people may not be able or willing to put a

price on certain values – e.g. environmental changes or preservation of endangered species – and this could lead to zero or protest bids (Crowards, 1995). They argue that there may be cognitive difficulties in isolating motivations. Moreover the list of possible motivations could be endless (Carson *et al.,* 1999). However, in the absence of more accurate methods, non-market valuation techniques have been shown to provide results that can still be used as tools in decision-making. Researchers propose minimizing these biases through judicious survey design and data analysis (Crowards, 1995).

Valuation of a resource that is not based on utilisation, as is the case of non-use value, implies that information on the resource has to have been acquired prior to elicitation of the value estimate. It has been argued that the stated preference estimates of non-use values may not be accurate since the values may vary with the level of information available to the respondents (Pearce & Özdemiroglu, 2002). Whitehead *et al. (*1994) carried out a study to assess the impact of information (or lack of it) on the validity and reliability of contingent valuation studies. They surveyed on-site users (respondents who had on-location experience with the natural resource), off-site users (respondents who had read or watched a program about the resource) and non-users (respondents who have never seen or heard anything about the resource). They found that the results obtained from the respondents who had acquired information both through personal experience and from the survey instrument led to reliable and valid results, and recommended that more effort be made in ensuring that respondents who aren't familiar with a resource are well informed prior to the survey.

2.4.2 Methods used in economic valuation of non-user benefits

It has long been a policy requirement to carry out benefit studies prior to infrastructure investment (Pearce & Özdemiroglu, 2002). Where the resource is a market good, market valuation approaches can be applied to infer value as evidenced from actual expenditure. Common examples are the consumer surplus for residential water and the price of water licences for agricultural or industrial purposes (Raucher *et al.,* 2005). Where the value of the resource cannot be inferred from market exchanges, as is the case with non-user benefits, interpretations can be made from surrogate markets or from creation of artificial markets as discussed below (Merino-Castello, 2003). A summary of the common valuation methods, their application and associated strengths and weaknesses of each method is presented in Table 2-5.

Surrogate market methods compute value either indirectly from observed patterns such as the cost of travel or by observing the variations in the market price of another related good, e.g. the effect of noise may be inferred from house prices. An advantage of revealed preference methods is that they are based on actual choices; the respondents are familiar with the trade-off, having to consider the internal costs and benefits of their choices (Young, 2005). The revealed preference methods are however unable to assess the impact of new policies or products and services that do not have any historical data (Merino-Castello, 2003).

Table 2-5: Summary of valuation methods

Methodology	Valuation Method	Description of Method and Data Sources	Application	Strengths & Weaknesses
Market valuation.	Observations of water market transactions.	Observed prices from lease contracts or sale of water rights. Estimate measured is the lower bound value. The cost of transaction is equal to the value of water.	Transactions within or between different uses of water i.e. agricultural, industrial, municipal, environmental.	Information readily available. Does not measure willingness to pay.
	Estimation of municipal water demand functions.	Statistical analysis of Municipal data. Derived market demand curve used to estimate consumer surplus and expenditure.	Demand for municipal sector deliveries (residential, commercial, government).	Data can be relatively easy to find (based on municipal records). Theoretically sound and widely applied. Can be used to determine marginal and average value.
	Cost of alternative supply.	Non-market value of water determined using substitute values for water services. The value of water inferred from the cost of alternative sources.	Waste water assimilation.	Difficult to determine assimilative capacity of water systems and residual loading.
	Cost savings approach.	Substitutes to the formal water supply (e.g. water from vendors or tanker trucks) are priced.	Industrial water use (similar application to residual imputation).	Useful in the absence of a demand curve. Requires accurate cost figures.
Surrogate market.	Residual imputation approach.	Value of a product used to infer the value of water (as an input to its production).	Industrial, commercial hydropower.	Not accurate if there are market distortions. Requires high degree of accuracy, i.e. errors result in inaccurate results.
	Hedonic pricing.	Data from municipal sources, from actual behaviour and choices. The value of water is based on the attributes, rather than water itself.	Municipal, agricultural, commercial, recreational.	Difficulty in detecting and isolating changes in price based on water.

Table 2-5: Summary of valuation methods (ctd)

Methodology	Valuation Method	Description of Method and Data Sources	Application	Strengths & Weaknesses
	Cost of illness.	Estimates lower bound values for WTP. Measures benefits by estimating possible savings from illness and opportunity costs due to illness.	Impact on human health.	Underestimates WTP. Does not take into consideration the disutility of illness or expenditure on coping mechanisms.
	Defensive behaviour method.	Analysis of actions taken to avoid incurring an external cost.	Valuation of reduced pollution.	
	Damage cost method. Also, avoidance cost approach.	Maximum WTP given as a monetary value of damages avoided. Value inferred from actions taken to avoid damages e.g. from exposure to pollution.	Valuation of reduced pollution or flood damage. Impact on human health.	Based on assumptions which must hold if values are to be accurate.
Artificial market.	Contingent valuation method.	Statistical analysis of survey questions asking for monetary valuation of proposed environmental changes. A market is created to simulate a desired situation and WTP values elicited.	Valuation of environmental changes or residential water services.	Questionnaire may be difficult to implement. Information cannot be transferred.
	Choice modelling.	Statistical analysis of survey questions asking respondents to make a choice between alternative outcomes of proposed environmental changes.	Valuation of environmental changes or residential water services.	
	Conjoint analysis.	WTP determined by ranking choices. WTP or WTA compensation for attributes of a good or service.		Ranking orders may obscure trade-offs regarding budget constraints.

(Raucher *et al.*, 2005; Young, 2005; Pearce &Özdemiroglu, 2002)

In circumstances where historical data or behavioural patterns are not available, stated preference methods are a more suitable technique than revealed preference methods (Merino-Castello, 2003). The methods involve inferring the value of the good based on data obtained from preference as expressed through statements of value (stated preference). Stated preference surveys can be used to construct several policy or environmental changes by building hypothetical scenarios, and for this reason have been widely applied in the valuation of new public projects and in market research to test the acceptability of new products. They are also recommended as one of the methods that can value non-use benefits (Merino-Castello, 2003).

2.4.2.1 Stated Preference surveys

Stated Preference (SP) methods can be traced to the 1960s when researchers in market research explained that choices can be regarded as a combination of attributes described in a set of alternatives (Lancaster, 1966). One of the strengths of the SP method is its ability to elicit preferences for individual attributes as well as alternatives (Humphreys, 2003). Further comparison between revealed and stated preference methods is summarised in Table 2-6. The stated preference techniques have since been adopted in transportation planning (Fowkes & Wardman, 1988) and environmental economics (Bateman *et al.*, 2002; Arrow *et al.*, 1993).

Table 2-6: Comparison of revealed and Stated Preference methods

	Revealed Preference	Stated Preference
Pros	Are based on actual choices. The respondents are familiar with the trade off, having to consider the internal costs and benefits of their choices. Are a better reflection of the values of the respondents since they are based on the observed costs and benefits. The estimates of willingness to pay are more valid.	Have the ability to measure non-use values for which no market price is available. Are flexible. Stated preference approaches can be used to construct several policy outcomes by building hypothetical scenarios.
Cons	Are unable to assess the impact of new policies or products that do not have any historical data.	Because of their hypothetical nature, respondents are sometimes placed in unfamiliar situations with no reference to make a choice.

(Merino-Castello, 2003)

There are two stated preference methods commonly used: the Contingent Valuation (CV) method and the Multi Attribute Valuation (MAV) method (Figure 2-3). The CV method elicits willingness to pay value statements by asking survey respondents to state how much money they are willing to pay for an envisaged policy change (Bateman *et al.*, 2003; Mitchell & Carson, 1989), while the MAV method determines the willingness to pay amount by asking the respondents to make a choice or trade-off between alternative scenarios in which the cost of each choice is included as an attribute.

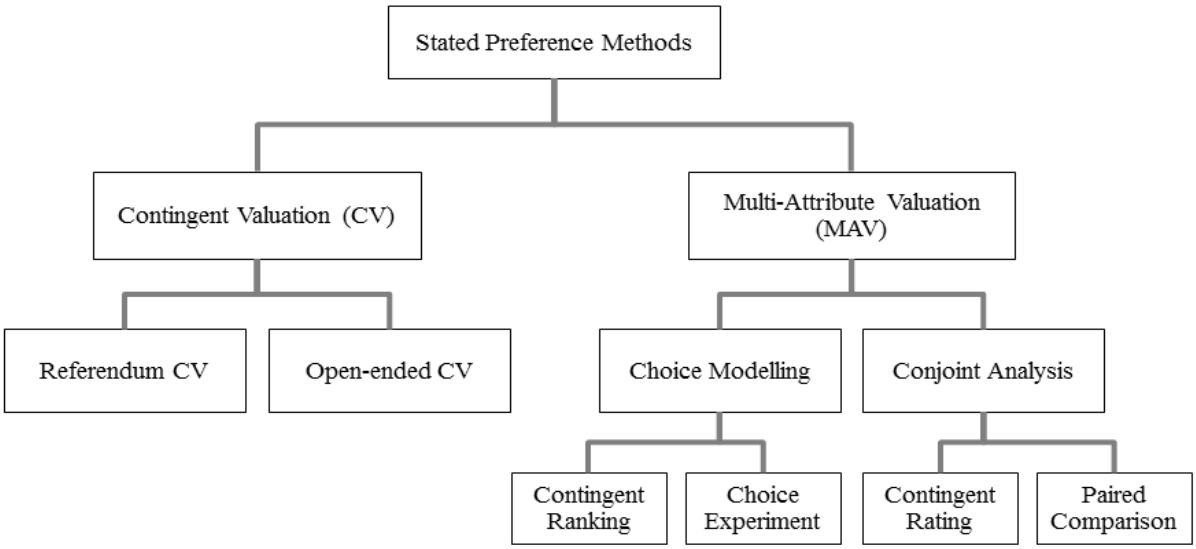

Figure 2-3: Stated Preference techniques
(Merino-Castello; 2003)

The CV techniques are the preferred option when the objective is to elicit a willingness to pay amount (Merino-Castello, 2003). The referendum / closed-ended format determines the willingness to pay amount by asking the respondents if they are willing to pay a stated amount (e.g. "Are you willing to pay USD 5 per month to have a tap in your house?") while open-ended format involves asking the respondents to state the maximum amount they are willing to pay (e.g. "How much money are you willing to pay every month for a tap in your house?") (Gutanilake *et al.*, 2007; Whittington, 2006). Some of the strengths and weaknesses of the CV and MAV methods as summarised in Merino-Castello (2003) are shown in Table 2-7.

Table 2-7: Comparison of Stated Preference methods

	CV method	MAV method
Strengths	Is flexible and can be used to estimate the economic value of use and non-use benefits. Is easy to analyse and describe. The willingness to pay value is expressed as a mean or median of the derived values. Has been applied for a longer time than MAV methods.	The approach of choosing between alternatives generates more information than a CV study. MAV is therefore cheaper to conduct. Multi-attribute methods may avoid some of the response difficulties that appear in CV e.g. bias associated with anchoring responses to a known value.
Weaknesses	The reliability of answers based on hypothetical situations which may not be familiar to the respondents has been questioned. Difficulty in defending and validating non-use values. May be prone to survey biases relating to lack of information and respondent biases towards a strategic outcome. Can be expensive and requires high competence levels to conduct.	The reliability of answers based on hypothetical situations which may not be familiar to the respondents has been questioned. Can be expensive and requires high competence levels to conduct.

(Merino-Castello, 2003; Bateman *et al.*, 2002)

The MAV method is the preferred choice of surveys when information is required on the attributes of the service (Pearce & Özdemiroglu, 2002). Generally, there are four elicitation techniques used in MAV surveys namely; discrete choice, ranking, rating and paired comparison (Merino-Castello, 2003). These are briefly described in Table 2-8.

Table 2-8: Comparison of the Stated Preference elicitation techniques

Elicitation Technique	Description	Pros	Cons
Choice experiment	Respondents are asked to state their preference based on descriptions of the proposed changes. Each change is described in terms of characteristics and the respondents are asked to trade-off between the alternatives.	Can be used to value use and non-use benefits. Thought to result in more accurate estimates than CV because it utilises preferences/trade-offs rather than direct monetary values.	The design process is time consuming (involves initial interviews and pre-testing questionnaires). Analysis of survey data is usually more complicated than CV. Has been used widely in market research but is largely untested in valuing non-market (public) goods. Uncertainty in results arising from translating hypothetical answers into monetary values.
Contingent Ranking	Respondents are asked to rank a set of alternatives from the most preferred to the least preferred.	Can be used to rank options from a list of scenarios.	Heavy cognitive burden. It is probably easy to identify the most preferred and the least preferred options, but it might not be so easy to rank the options in between.
Contingent Rating, **Paired Comparison**	Respondents are shown different representations of the good and are asked to state the strength of preference from either a list or a pair.	Questionnaire is simpler to design than the choice experiment.	Strong assumptions are required to transform ratings into utilities e.g. the same rating by two respondents may not necessarily mean that the two answers are identical.

(Young, 2005; Merino-Castello, 2003)

Although stated preference surveys have been applied extensively in benefit studies, there is still considerable debate on both the conceptual and the methodological issues of their implementation as measurement tools for non-market goods. With respect to valuation of non-user benefits, there is generally consensus that individuals may value a good or a service that they do not use or have no intention of using. There are however conceptual debates which concern, not the existence of non-user value, but whether these values can be measured; if the values are actually comparable with monetary value; or if they are of significant magnitude as

to make them worthy of measuring (Cummings & Harrison, 1995 in Crowards 1995). There is a school of thought that asserts that components of value can be deconstructed during the survey, and the willingness to pay estimates validated by using a different valuation technique. There are also methodological debates surrounding issues of validity and reliability of the results from the surveys resulting from biases that could arise from value placed on a hypothetical good. Gutanilake *et al.,* (2007) and Crowards (1995) propose minimizing these biases through judicious survey design and data analysis.

2.4.3 Theoretical framework for modelling choice

The modelling of choice follows rational economic theory since indirect steps are taken prior to expression of a preference (i.e. "raw goods" such as choice of travel, are transformed to provide utility or satisfaction of employment) (McFadden, 2001). The underlying behaviour of people's choices is based on the notion that people make choices after consideration of all available alternatives and will choose a particular option because it represents the source of greatest utility or satisfaction compared to the alternatives presented (Hensher *et al.,* 2005). In a choice scenario, respondents are requested to choose their preferred alternative presented as a set of different attributes that describe the alternative. In order to determine the willingness to pay, a budgetary constraint (e.g. time, money) is included among the attributes. It has been shown that given an individual's preferences, available budget and the price of alternative goods, the relationship between the alternatives can be modelled (Hensher *et al.,* 2005).

The standard choice models are based on the respondents' taste, experience and personal characteristics, which may contain both observed and unobserved characteristics as determinants of preference. As illustrated in Figure 2-4, the choice outcome (e.g. of a preferred level of service) will be influenced by the experiences and information relating to that level of service, and based on an assimilation of the budget and the alternatives available (i.e. the utility formulation process), the respondents will make a choice that provides the highest level of utility/satisfaction (MacFadden, 2001; Louviere *et al.,* 2000). The choice process can however be difficult to observe due to the variability (heterogeneity) in taste and experience among the sample population. Choice modelling involves measuring the observed heterogeneity and finding ways of minimising the unobserved heterogeneity. This requires careful definition and description of the alternatives to reflect reality (during the survey development and implementation) and use of relevant attributes that are recognisable by the respondents (Hensher *et al.,* 2005; Pearce & Özdemiroglu 2002).

2.4.3.1 Model specification

Choice modelling is based on the premise that a good or resource can be described in terms of its attributes (e.g. a car can be described in terms of comfort, cost, colour, etc.) and different levels of these attributes may change the utility derived from the good. By presenting a respondent with attributes at different levels, a choice experiment is able to generate

information on the trade-offs / choices between alternatives (Louviere *et al.*, 2000). The respondents' choices are analysed using random utility theory, which states that a respondent will choose the alternative which offers the greatest utility from the choice of alternatives offered (Louviere *et al.*, 2000).

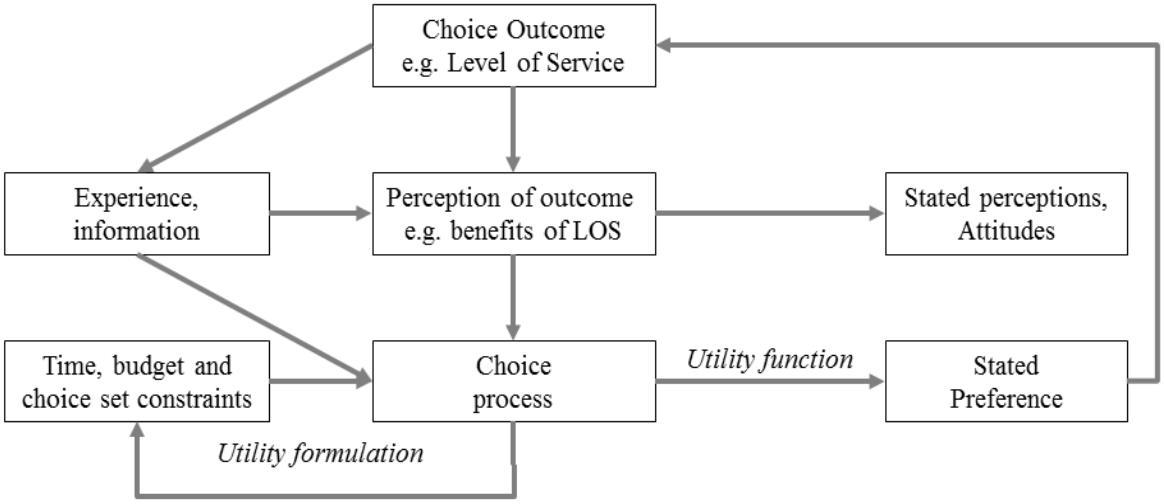

Figure 2-4: The Stated Preference process
(McFadden, 2001; Louviere *et al.*, 2000)

The utility of an alternative can be expressed as a function of its attributes and certain characteristics pertaining to the respondent. The utility function is expressed as:

$$U_i = V_i + \varepsilon_i \tag{2-1}$$

where U_i represents the utility of choosing alternative i, V_i represents the observable hence deterministic component of utility, and ε_i represents a random component unobservable by the researcher but known to the individual.

The Random Utility Model (RUM) tries to minimise the difficulties resulting from failure to accurately express the dependence on experience and tastes by assuming that the unobserved characteristics are heterogeneous across a sample and are continuous (e.g. taste changes with age) (Louviere *et al.*, 2000). This implies that the distribution of unobserved characteristics is dependent on the observed characteristics. This condition can be incorporated into the utility function such that the dependence of unobserved characteristics is represented as a continuous function of a uniformly distributed random vector. The set of unobserved components, each with their own unique mean, are not correlated and exhibit the same distribution (i.e. identically distributed). Humphreys (2003) summarises possible reasons for the inclusion of this random term:

i. There may be measurement errors or biases in the observable attributes.

ii. There may be unobservable influences which are unknown to the researcher but affect the choice outcome (e.g. a respondent's preference for the train, based on the availability of a newspaper, despite the fact that it costs more in time and money to travel by train).

iii. Individual tastes may vary across the population (e.g. not all individuals would value the opportunity to read the newspaper).

iv. There may be differences between the perceptions of the options by the researcher and by the respondent.

The observable component of utility V_i is expressed in the linear form:

$$V_i = \beta_{0i} + \beta_{1i}X_{1i} + \beta_{2i}X_{2i} + \cdots + \beta_{ki}X_{ki} \quad (2\text{-}2)$$

where β_{1i} is the weight associated with attribute X_1 and alternative i and β_{0i} is an alternative-specific constant that corresponds to the influence of the unobserved sources of utility. The contribution of each of the attributes to the overall level of utility for that alternative $\beta_{1i}\, X_i$,, is a "part-worth" utility which is a measure of relative utility of one alternative over the other. Alternative i is chosen over Alternative j if $U_i > U_j$ i.e.:

$$V_i + \varepsilon_i \geq V_j + \varepsilon_j \quad (2\text{-}3)$$

The probability that the respondent chooses alternative i from a choice set can be represented as:

$$P_i = P\left(V_i + \varepsilon_i \geq V_j + \varepsilon_j\right) \quad (2\text{-}4)$$

Rewriting:

$$P_i = P\left(\varepsilon_j - \varepsilon_i < V_i - V_j\right) \quad (2\text{-}5)$$

In other words, the probability that an individual will choose alternative i is the probability that the influence of unobserved characteristics of the alternatives is less than the difference between the deterministic utility levels of the alternatives i and j. The goal of the choice models is to estimate the significance of the determinants of the deterministic utility, V for each individual. The conditions for developing individual choice models as stated in Louviere *et al.* (2000) are:

i. Independence from Irrelevant Alternatives – IIA. This states that the ratio of the probabilities of choosing one alternative over another (given that both alternatives have a non-zero probability of choice) is unaffected by the presence or absence of any additional alternatives in the choice set. This allows introduction and/or elimination of alternatives in choice sets without re-estimation. IIA implies that all cross effects are equal (i.e. if an attribute gains in utility, it draws shares from other attributes in proportion to its contribution to current utility).

ii. The probability of choosing an alternative must be greater than zero for all possible alternatives in the choice set.

The conditions above imply that the random elements of utility are independent and identically distributed (IID). The choice models are estimated based on assumptions of the probability distribution of the random component, ε in the utility equation. An assumption of normally distributed errors results in the Multinomial Probit model. The drawback with this assumption is that it involves computation of probabilities using simulation methods, which can be lengthy and problematic (Koppelman & Bhat, 2006). The Gumbel distribution on the other hand, is similar to the normal distribution (i.e. equal mean and variance), but does not require simulation or numerical integration to estimate the model (Hensher *et al.*, 2005). The Gumbel distribution, also known as the Extreme Value type 1 (EV1), is expressed as a double exponential, ε = -log(-log ε)with a closed integral, which facilitates the elimination of the random component ε, and leaving the only unknowns to be the utility parameters associated with each attribute in the observed component of the random utility expression. This results in the multinomial logit model, expressed as:

$$P_i = \frac{\exp(V_i)}{\sum_{j=1}^{J} \exp(V_j)} \quad (2\text{-}6)$$

where P_i *i*s the probability of an individual choosing alternative *i;* V_j is the deterministic component of the utility of alternative *j*.

In other words, the probability of choosing an alternative *i* from a set of *j* alternatives is the quotient of the exponent of utility for the alternative *i* divided by the sum of the exponent of the utility of all alternatives. The model is estimated using the maximum likelihood method (i.e. the maximum likelihood that the choice estimated by the model is the actual choice in the sample).

The Multinomial Logit Model (MNL) is characterised by three properties: (i) the Independence of Irrelevant Alternatives (IIA), which results in the ratio of probabilities of any two alternatives being independent; (ii) the dependence of the choice probabilities on the difference in deterministic utility between the alternatives; and (iii) the "S" shape of the probability distribution curve, which limits the range of probabilities between zero and one, such that the probability of choosing an alternative increases with increasing utility for that alternative, but decreases with increasing utility of the alternatives (Koppelman & Bhat, 2006).

The above properties imply that differences in probabilities only occur as a result of differences in the deterministic utilities of alternatives, which are assumed to be independent of each other. As a result, the MNL assumes a uniform pattern of substitution between alternatives, which does not always actually happen, i.e. there could be correlations in the error components (i.e. the alternatives may share the same unobserved variables / tastes), and there

may also be correlations between the alternatives. The violation of these assumptions lead to biases or illogical parameter estimation (coefficients bearing the wrong sign). In order to correct for these weaknesses, the MNL models can be modified to relax constraints requiring identical error distributions (the mixed logit models for example, take into account the tastes of respondents and accommodate correlations among observations), or relax the IIA assumption (the nested logit models assume different distributions of the error terms following a decision making tree) (Willis & Scarpa, 2006; Louviere *et al.,* 2000).

2.4.3.2 The Nested Logit model

The Multinomial Logit Model (MNL) is usually the starting place for modelling SP data, primarily due to its ease of estimation and interpretation (Koppelman & Bhat, 2006; Hensher *et al.,* 2005). The assumption of Independent and Identically Distributed (IID) alternatives that renders the MNL easy to estimate can however be a limitation when the underlying behavioural association, the Independence of Irrelevant Alternatives (IIA), is not met. The IIA property requires the ratio of the choice probabilities of a pair of alternatives to be independent of any other alternative in the choice set. This implies that all pairs of alternatives are equally competitive, i.e. the influence of the random components is the same between pairs of alternatives and across all alternatives, and thus the introduction of a new alternative would reduce the probability of the existing alternatives in the same proportion as before (Koppelman & Bhat, 2006; Hensher *et al.,* 2005). This IIA property can be violated in circumstances where some alternatives are more similar than others or where there is important information that has been excluded from the deterministic component of the model, leading to correlation between the errors associated with the alternatives. In these circumstances, the MNL model would estimate coefficients based on inaccurate substitution of choices and thus result in wrong predictions (Koppelman & Bhat, 2006). Several models have been developed that are based on different assumptions of the random component of the RUM, e.g. the nested logit model, and the mixed logit model.

The overarching assumption in developing a Nested Logit (NL) model is that some alternatives bear similarity in the error component, which can be deconstructed into parts: one part associated with the alternative and one part associated with groups of alternatives (nests). The NL model allows for similarity of alternatives by assuming different variances between groups of alternatives, nested into trunks, limbs, branches and elemental alternatives (see Figure 2-5), such that the probability of choosing an alternative is contingent on the choice of branch, limb and trunk.

The utility functions for the elemental alternatives can be expressed as follows:

$$V_{1i} = \mu_1\beta_{oi} + \mu_1\beta_{1i}X_{1i} + \mu_1\beta_{2i}X_{2i} + ... + \mu_1\beta_{ki}X_{ki} \qquad (2\text{-}7)$$

$$V_{2i} = \mu_2\beta_{oi} + \mu_2\beta_{1i}X_{1i} + \mu_2\beta_{2i}X_{2i} + ... + \mu_2\beta_{ki}X_{ki} \quad (2\text{-}8)$$

where μ_1 is the scale parameter for the elemental alternative 1 and μ_2 is the scale parameter for the elemental alternative 2.

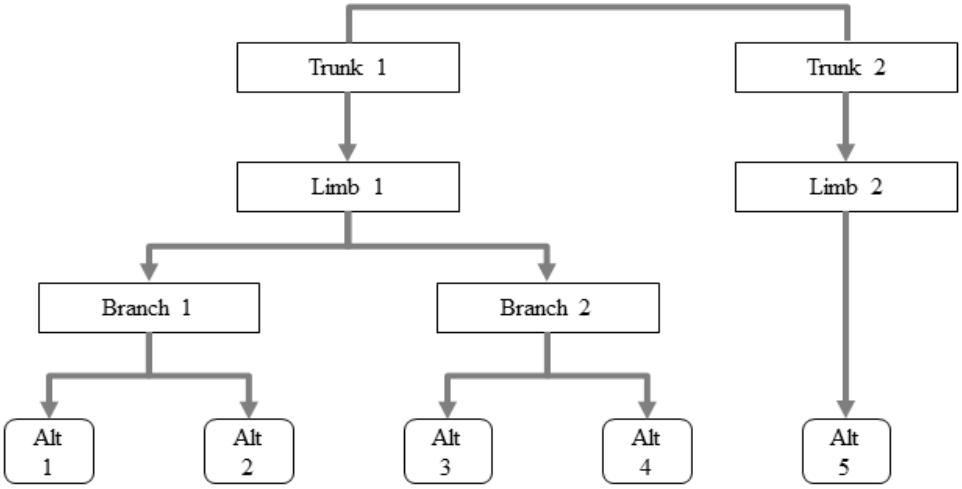

Figure 2-5: A 4-level nested tree structure
(Hensher *et al.*, 2005)

The scale parameter describes the distribution of the variance of the unobserved effects of an alternative. The IID assumption of MNL models allows simplification of model estimation by setting equal variance between alternatives, thus negating the need to estimate different scale parameters for each alternative. In cases where the variances between alternatives differs (when there are similarities between groups of alternatives), it becomes necessary to estimate a scale parameter for the similar alternatives, nested at the elemental level and a scale parameter for the composite (branch) level. Level 2 of the nested tree implies a marginal choice between the branches and a conditional choice between the elemental alternatives, given that the corresponding branch has been chosen i.e. choice of alternative 1 is conditional on Branch 1 (B_1) being chosen. The link between the branch and elemental alternative in the utility function is expressed via the logsum, also called the Inclusive Value (IV) as illustrated below:

$$V_{B1} = \beta_{oB1} + \beta_{1B1}X_{1B1} + \beta_{2B1}X_{2B1} + ... + \beta_{kB1}X_{kB1} + (\frac{\lambda_{B1}}{\mu})IV_{k+1B1} \quad (2\text{-}9)$$

As explained by Hensher *et al.* (2005), the IV is a computational value, obtained by searching for all possible values of V_j for all elemental alternatives falling under a composite alternative, i.e. maximise utility V_j for all the elemental alternatives under Branch 1 for elemental alternatives 1 and 2, as shown below:

$$\mathrm{IV_{BRANCH1}} = \log(\exp^{V_1} + \exp^{V_2}) \quad (2\text{-}10)$$

λ_{B1} is the scale parameter (the nesting coefficient), associated with the composite level B_1, while μ is the scale parameter associated with the elemental alternatives (usually normalised to 1). The ratio of the scale parameters indicates the degree of similarity between the choices. As summarised in Koppelman & Bhat (2006), the conditions for interpreting the scale parameter estimate λ(also called the nesting coefficient, IV parameter or logsum parameter), are as follows:

- If $\lambda > 1$ or $\lambda < 0$, the model is not consistent with the theoretical derivation therefore reject the NL model.
- If $\lambda = 1$, there is zero correlation among elementary alternatives in the nest. The NL model collapses into an MNL model.
- If $0 < \lambda < 1$, there is a non-zero correlation among elementary alternatives. This is the appropriate range of values for the scale parameter λ.
- $\lambda = 0$ implies perfect correlation between alternatives in the nest i.e. the choice between the nested alternatives, conditional on the nest, is deterministic. The upper and lower levels contain 2 independent choice models.

2.4.3.3 Testing model effects

The utility functions derived from choice experiments are determined by the values that are used to describe the attributes of the alternatives. In the MNL models, it may therefore not be able to interpret the effect of the variable on the probabilities, beyond the sign of the coefficient (Hensher *et al.*, 2005). Derivatives and elasticity are commonly calculated to investigate the changes in model outcome as a result of changes in the explanatory variable.

Derivatives measure the change in probability of choosing an alternative as a result of a change in the attributes. As illustrated in Koppelman &Bhat (2006), the expression for the derivative can be expressed as:

$$\frac{\partial P_{iq}}{\partial X_{ikq}} = \frac{\partial V_{iq}}{\partial X_{ikq}} * P_{iq} * (1 - P_{iq}) \qquad (2\text{-}11)$$

where $V_{iq}$is the utility function as specified in equation (2-2). The equation describes the probability P_{ikq}, of alternative i for respondent q in response to a change in the k^{th} attribute of the i^{th} alternative. The utility function is reduced to:

$$\frac{\partial P_{iq}}{\partial X_{ikq}} = \beta_k * P_{iq} * (1 - P_{iq}) \qquad (2\text{-}12)$$

where $\beta_k$is the coefficient of attribute k. When it is desired to measure the change in the choice probability of alternative j as a result of changes in the attributes of a competing alternative i, cross derivatives may be utilised. The cross derivative can be expressed as:

$$\frac{\partial P_{iq}}{\partial X_{ikq}} = -\beta_k * P_{iq} * P_{jq} \quad (2\text{-}13)$$

where i≠ j. The sign of the coefficient β_k is opposite when calculating the cross elasticity, indicating that where β_k is positive, an increase in X_{ikq} will decrease the probability of choosing alternative *j*, and vice versa for where β_k is negative.

Elasticities measure the percentage change in the probability of choosing an alternative in response to a change in attribute, as illustrated below:

$$E_{X_{ikq}}^{P_{iq}} = \frac{\left(\frac{\partial P_{iq}}{P_{iq}}\right)}{\left(\frac{\partial X_{iq}}{X_{iq}}\right)} = \frac{\partial P_{iq}}{\partial X_{ikq}} * \frac{X_{ikq}}{P_{iq}} \quad (2\text{-}14)$$

The equation describes the change in probability of choosing alternative *i* for respondent *q* in response to a change in X_{ikq} (the k^{th} attribute of the i^{th} alternative). Similar to derivatives, the direct elasticity represents a percent change in choice probability based on a change in an attribute of that alternative and the cross elasticity represents a percent change in the probability of choosing an alternative based on a change in attribute of a competing alternative. Substituting the expression for derivatives into the equation (2-15) simplifies this equation, thus expressing the direct point elasticity as:

$$E_{X_{ikq}}^{P_{iq}} = -\beta_{ik} X_{ikq}(1 - P_{iq}) \quad (2\text{-}15)$$

and the cross-point elasticity for alternative *j* as:

$$E_{X_{jkq}}^{P_{iq}} = -\beta_{jk} X_{jkq} P_{jq} \quad (2\text{-}16)$$

where *j≠i*.

When the attributes are continuous variables, the elasticity is calculated as point changes in the value of the attributes, otherwise for categorical or dummy-coded variables which cannot be differentiated, the changes in probabilities are calculated with respect to a unit change in variable. Studies show that residential water supply exhibits a low price elasticity of demand (Raucher *et al.,* 2005). Furthermore, lower elasticity is observed for basic uses of water compared to other uses such as gardening(Raucher *et al.,* 2006). Studies show that elasticity estimates for basic water use ranged from -0.13 to -0.47, irrespective of income group of the respondents (Veck & Bill, 2000). This means that at a basic level, residential water is not responsive to changes in price. However, Jansen & Schulz (2006) found that price elasticity among the high income population in Cape Town (highest income segment -0.99) differed significantly from the rest of the population (lowest income segment -0.23). They recommend

that water policies and tariff designs take cognisance of the potential responses of different income groups on price changes to ensure equity and effective water demand management. Interpretation of elasticity values are summarised in Table 2-9.

Table 2-9: Interpretation of elasticity calculations on revenue

	Absolute value of elasticity	Direct elasticity	Cross elasticity	Price increase	Price decrease
Perfectly inelastic	$E_{Xi} = 0$	1% increase in X_i results in a -∞% decrease in P_i	1% increase in X_i results in a -∞% increase in P_j	Revenue increases	Revenue decreases
Relatively inelastic	$0< E_{Xi}<1$	1% increase in X_i results in < 1% decrease in P_i	1% increase in X_i results in < 1% increase in P_j	Revenue increases	Revenue decreases
Elastic	$E_{Xi} = 1$	1% increase in X_i does not change P_i	1% increase in X_i does not change P_j	Revenue unchanged	Revenue unchanged
Relatively elastic	$1< E_{Xi}<\infty$	1% increase in X_i results in > 1% decrease in P_i	1% increase in X_i results in > 1% increase in P_j	Revenue decreases	Revenue increases
Perfectly elastic	$E_{Xi}=\infty$	1% increase in X_i results in an ∞% decrease in P_i	1% increase in X_i results in an ∞% increase in P_j	Revenue decreases	Revenue increases

(Hensher *et al.,* 2005)

2.5 Evidence of non-user value

"Water helped …. man learn those first lessons about the rights of others and responsibility to a larger society…." (Meyer, n.d)

The section discusses a selection of recent studies and is aimed at highlighting the common research findings that are relevant to this study; i.e. that the non-use value is a significant component of total economic value, and that the methodologies used in the measurement of non-use value can result in reliable estimates which can be used in policy analyses and in investment appraisals.

2.5.1 Empirical evidence

The debates on the conceptual and methodological issues related to valuation of non-use benefits have for a long time been restricted to the academic research arena, with limited application in benefit studies and policy analyses. As discussed below, the empirical evidence indicates that non-use value may form a substantial component of total economic value and make the case for their inclusion in decision-making (Crowards, 1995; Harpman *et al.*, 1994).

Sanders *et al.* (1990) estimated the total value of preserving scenic rivers in Colorado, and found the non-use component to be about four times the use value component. Bullock (2006) valued urban green space in Dublin, Ireland using a questionnaire and choice

experiments. A factor analysis was initially applied to 40 attributes to identify reasons for park use, and was then followed by a choice experiment to determine the value of the different attributes. The initial MNL model had a rho-squared value of 0.113, which was improved with a mixed logit, by arguing that the MNL produces average parameter values and thus does not incorporate variability in the attributes. Bullock (2006) found that utility could vary depending on the purpose of visit, and on socio- demographic characteristics. The data was split into subsets and a random parameter model (mixed logit) was used to explain the variation in the data. The mixed logit model resulted in a model significance of 0.433. It was also found that the model that included the status quo option resulted in a better model fit than when the stated preference data was analysed alone. This was attributed to the actual collinearity between attributes in an actual situation. Although combining SP and RP grounds the survey in reality, in this case it may also have diluted the orthogonality of the SP design. The assumption of IID of errors is violated when RP data are added to SP data of different respondents.

Willis & Scarpa (2006) valued the benefits of changes in water and sanitation service levels in Yorkshire, UK. They used 14 attributes to determine the use, option, non-use and altruistic value of improving different aspects of water, sanitation and environmental conditions. They faced challenges in the experimental design and raised concerns about the cognitive ability of respondents to choose between a large number of attributes. Presentation of many attributes rendered it difficult to trade off one factor against another. They recommended a heuristic rule of a maximum of four or five factors that can be reasonably analysed for consistent responses. They proposed two methods to reduce large numbers of attributes:

- Use of a set of generic attributes (e.g. one factor representing each element under valuation): one for the water supply, another for the sanitation and another for the environmental benefits, and include cost as a separate factor to determine WTP for the generic factors.
- Blocking the factors into small groups with a price change attached to reduce the number of attributes presented to a respondent.

Willis & Scarpa (2006) determined the WTP and the change in willingness to pay with changes in LOS. They also determined variations of WTP among the socio-demographic groups, thus testing acceptability of changes in LOS. The results of their study were used by the water company to submit a business plan to the British water regulator.

In transportation research, option and non-use value have been found to be a significant component of TEV. Laird *et al.* (2009) summarised economic values from three transportation studies, and found that option and non-use values range from 20-51% of TEV. Bristow *et al.* (1991) developed a methodology to identify and measure direct use value (derived from accessibility benefits), option value (possible future use), indirect use value (derived from benefits associated with the reduction of congestion and environmental pollution) and altruistic value (derived from the knowledge that public transportation will

benefit others). The survey instrument, developed over a 12-month period, included exploratory surveys and pilot tests to identify context-specific issues and determine ways to get stakeholders to conceptualise the non-user benefits they derive from public transportation. Eight pilot tests, conducted over several locations were used to:

- Test different elicitation methods, *viz* iterative bidding, open-ended CV questionnaires, a self-completion questionnaire followed by an interview, a hedonic question and a self-completion travel diary followed by a face-to face interview.
- Investigate the acceptability of different payment vehicles, *viz* property taxes, poll tax, income tax and user charges.

The number of fully completed questionnaires and the accuracy of stated benefits were used as an indication of the effectiveness of the survey approach. The answers from the interviews were compared with those from the questionnaire to determine the effectiveness of the questionnaire in eliciting accurate and consistent responses. It was found that the respondents faced difficulty in conceptualising the non-user benefits, indicating a need for a survey method that allows for clarification. The study determined an average non-use value amounting to between 39% and 50% of TEV, which is comparable to previous studies.

Painter *et al.* (2006) tested the use of a CV method to measure the user and non-user benefits of rural transit in the USA. They used Focus Group Discussions (FGDs) to investigate the nature and extent of benefits, and followed these with a random sample telephone survey to collect socio-economic and demographic data on the sample population. The benefits identified from the FGDs were direct benefits (pertaining to accessibility in terms of cost, safety, reliability and convenience); direct economic benefits (pertaining to job opportunities); indirect benefits such as social benefits (improving accessibility to children and the elderly); environmental benefits (reduction in pollution and congestion) and community values (desire to encourage economic development in smaller communities). A CV questionnaire was submitted to a sample population comprising respondents recruited through a telephone survey and from the local church and community groups. While this sampling strategy was convenient, it limited the ability to aggregate the survey results (since there was no guarantee of representativeness of the sample). However, in view of the time and cost implications of conducting a survey of a randomly selected population, the researchers deemed the methodology to be appropriate and proposed that it would result in a fairly acceptable representation of the population's preferences. The CV questions were designed to progressively isolate the use and non-user benefits and thus avoid potential biases in responses. They used a tobit model to estimate the model parameters and found that unlike many demand studies, income was not a highly significant parameter. The altruistic desire to provide public transport to others was however highly significant in explaining the WTP values. They attributed this discrepancy to the sampling method used which included selective sampling from church and community service groups. They also found that identification of the non-user population was important for accurate aggregation of benefits, and recommended aggregating

individual adults for non-use benefit studies rather than aggregating using households as is the common practice. They made a distinction in their definition of existence benefits from the pure existence benefits described in environmental economics. Existence benefits, according to their study, refers to the direct and indirect benefits that non-users receive from the existence of the system (e.g. as a social amenity). This definition is comparable to the definition of functional indirect use benefits described in Section 2.4.2, and may also strengthen the argument that TEV is the sum of use and non-use benefits and is not about the motives of the respondent. They found that non-use value amounted to an average of 74% of TEV.

Humphreys (2003) applied stated preference techniques to value the perceived indirect and non-user benefits in the rail sector in the UK. The survey involved asking respondents to rate a list of indirect and non-use benefits such as provision of access to remote communities and reducing congestion. Different approaches to asking the questions were tested for relative ease of answering and appropriateness of questionnaire length. The responses from the pilot study (n=19) were analysed with a binomial logit model (BL) and results were found to be consistent with theory and with previous studies. The pilot also tested effectiveness of the payment vehicle and payment ladder, duration of payment and elicitation format. A CV method and choice experiment was applied to 200 respondents and conducted over a 2-month period. This study determined that the total non-use value, including option value and altruistic value, for users of the rail system amounted to 40% of their gross total economic value.

2.5.2 Evidence in policy and practice

In the environmental sector, the first application of non-use values in practice was reported in a court case in the United States in 1989. The U.S. Court of Appeals ruled in favour of a case that used non-use values measured using the CV method to determine the total economic value of damages caused by an oil spill. The court ruled that public resources may possess passive use, which reflect utility and thus ought to be included in damage assessments (Harpman *et al.*, 1994). This ruling led to the development of guidelines on the application of contingent valuation studies in environmental assessment studies (Arrow *et al.,* 1993). The guidelines, developed by the National Oceanic and Atmospheric Administration, concluded that the CV method can produce estimates of non-use values which are reliable and can be used in environmental damage assessment in administrative and judicial decisions (Arrow *et al.,* 1993). Since then, assessment of non-user benefits has been incorporated into preparation of public projects.

In the transportation sector, non-user benefits have been used as a mechanism of revenue generation for financing transport infrastructure since the 19th century. The notion of value capture, as a means of increasing capital finance for infrastructure projects was initiated after it was noticed that although everyone benefited from paving streets (i.e. cleaner air and easier access), landowners whose properties were located near the paved streets benefited more (their land became more valuable than properties on unpaved streets) (Rybeck, 2004). This pattern of

benefits accruing to non-users was noticed consistently. Property values always increased with the introduction of a transportation system. The mechanism of value capture was therefore developed to harness this increase in property values through property tax (Rybeck, 2004). Subsequent studies have shown that implementing value capture stimulates economic development as landowners strive to develop the land in a bid to maximise returns on the higher rate on land. Studies also show that value capture is generally politically acceptable since it results in reduced tax burdens on residential and business properties (Rybeck, 2004). In the transportation sector in the UK and the Netherlands, the potential importance of option and non-use values in appraisals has been investigated (Laird *et al.,* 2009; Geurs *et al.,* 2006) and guidelines have been developed to incorporate option values into appraisals by the Department of Transport (Department of Transport, 2007).

In the water sector, the world business community have recognised the direct impact of poor water and sanitation services on their operations (through reduced work time, productive capacity and purchasing power due to disease) and are making contributions to improve water services in the countries that lie in their value chain. For example, under the auspices of the World Business Council on Sustainable Development, several large multinational companies (e.g. Coca-Cola, Cadbury, Procter & Gamble) are investing in improving water services in developing countries (WBCSD, 2008).

2.6 Summary

This literature review aimed at answering the following questions:

i) What are the principles and practice of delivering urban water and sanitation services and how do they affect the poor?

ii) What challenges do municipalities face in the delivery of water and sanitation services to informal settlements?

iii) Are all value perspectives incorporated in the typology of value for urban water services?

iv) What is the concept and definition of non-user value? Is there evidence of non-user value either in empirical research or in practice, and can the valuation methodologies adequately capture the non-user value of urban water services?

The literature review has highlighted some of the technical and financing challenges faced by municipalities in improving services in informal settlements. The literature review has also discussed the impact of poor water and sanitation services on the poor, and identified the need to strengthen institutional capacity, to encourage stakeholder participation in planning, and to exploit the collective affordability among the members of society who can afford, to pay for improving services of those who cannot afford to pay.

A low recognition of non-user benefits associated with improved water and sanitation among the poor, coupled with a lack of consensus on the identification and measurement of non-user benefits were identified as some of the gaps in the valuation of urban water services. An exploration of the transportation and environmental literature revealed that there is willingness among the "non-poor" members of society to pay for the benefits of public resources even if they do not use them directly, and this could be applied to the urban water sector.

The conceptual and methodological discussions on the concept and measurement of non-user value, as drawn from the transportation and environmental literature reveal that valuation methodologies exist and have been applied successfully to measure non-user value of various public services. The provision of urban water services was explored within the context of public goods theory, and a value typology that facilitates the identification of beneficiaries was proposed.

The objective of this thesis was to investigate the value of non-user benefits as a potential resource that could be used to leverage additional financing for improving services to informal settlements. The techniques identified in this literature review were developed in Chapter 3, and implemented in two cities as discussed in Chapter 4 and Chapter 5. It should be noted that the conceptual and methodological discussions in this literature review were based on transportation, water resources and environmental literature and a wide body of literature is also available in other areas such as health economics and market research.

3. The valuation of non-user benefits of urban water and sanitation services

3.1 Introduction

The conceptual framework for this study embodies two areas of interest: the notion that the public may be willing to pay for the benefits of a service that they do not use directly; and the identification and valuation of these benefits. The literature review revealed that there are benefits to society that are not captured by the valuation system on which water pricing strategies are based. The willingness of society to pay for water services is driven by their perception of the value/benefits that they receive from access to the service, and influences the ability of the municipality to collect revenue. The impact of consistent under-valuation of benefits is that municipalities are not able to raise adequate revenue for operational activities, for maintenance and rehabilitation, and for expansion of services to new areas and this results in infrastructure degradation and poor quality of services. As illustrated in Figure 3-1, infrastructure degradation and low levels of service result in high social, environmental and economic costs (e.g. inadequate maintenance of the sewer network would result in high environmental pollution) which lower the perception of value and erode the willingness to pay for the service among society (Moss *et al.*, 2003).

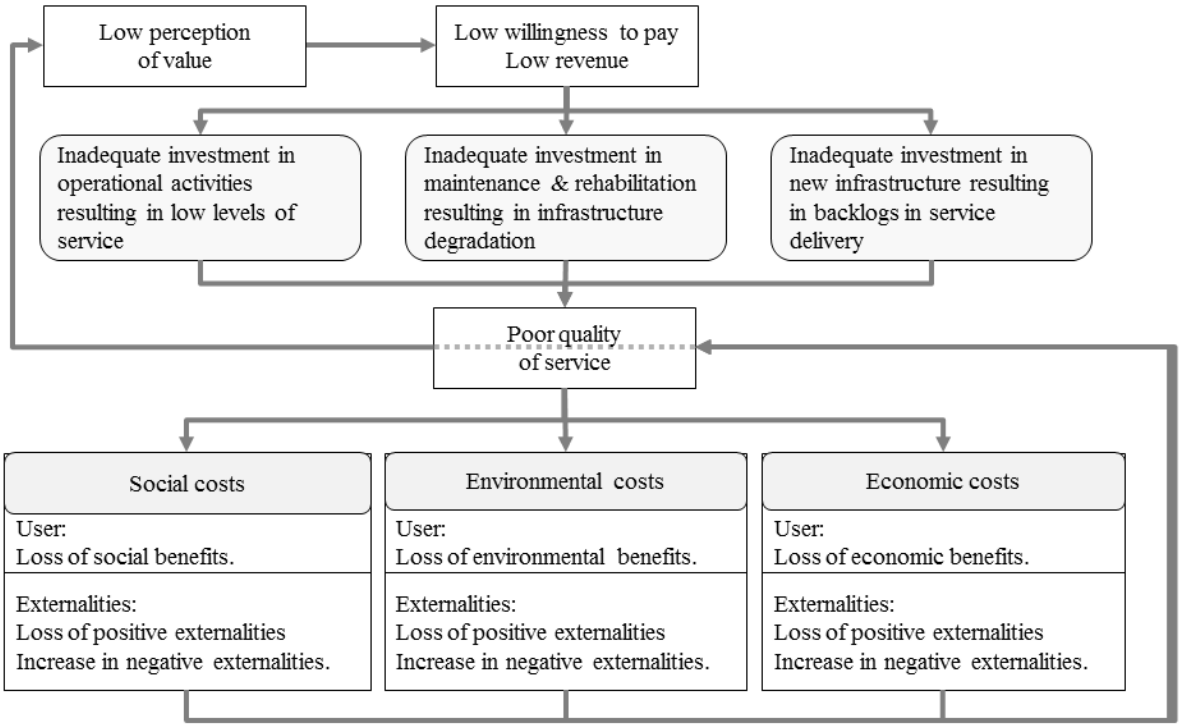

Figure 3-1: Value perceptions and financing water and sanitation services

Water services are usually financed through a combination of public funds (through government transfers), private financing and user charges. The level of service provided by a municipality is dependent on the availability of funds to address infrastructure backlogs, meet the municipality's growth needs and carry out operation and maintenance. One of the objectives of a municipality's pricing structure is to balance the funds available from private financing, public subsidies and the funds raised through user fees. As explained in the preceding section, the willingness to pay for service is driven by the perception of the benefits associated with the service. Conventional valuation studies assess the direct user benefits of improving services and thus any third party benefits are not reflected in the pricing of water services. As shown Figure 3-2, valuation of the benefits of improving service to the poor to other stakeholders (e.g. government, private households and the private sector) has the potential to increase the financing available for level of service improvements. The literature review revealed that the valuation methods used in transportation and environmental research can produce realistic estimates of non-user value. This study explored the application of these methodologies in the context of urban water services and investigated the potential of non-user value in increasing the resource pool for financing of water services.

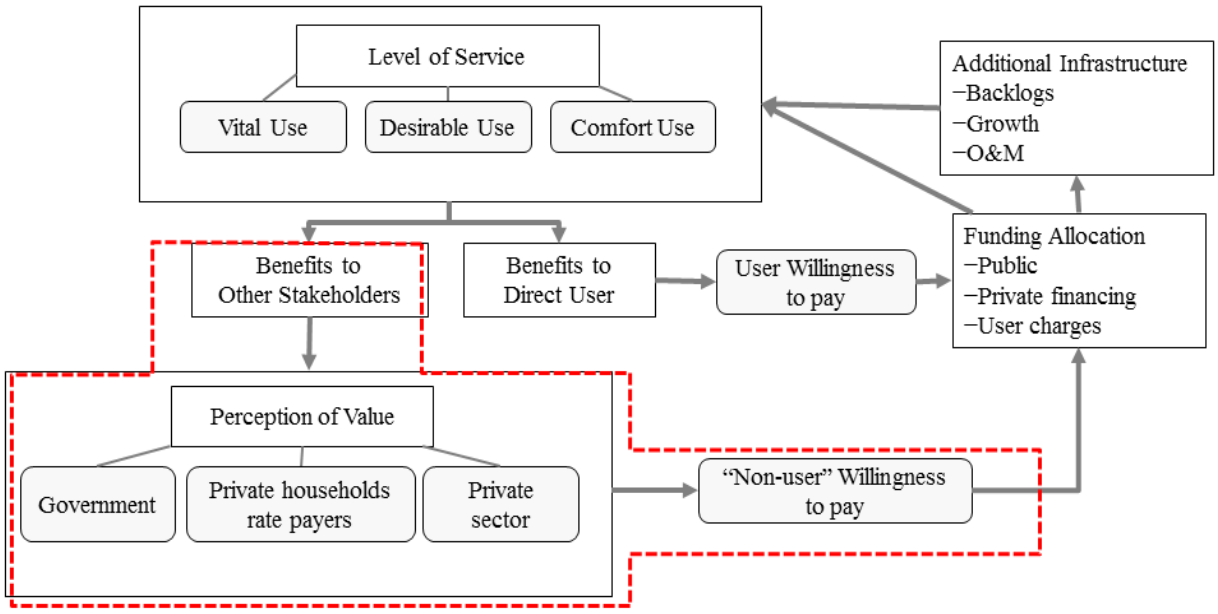

Figure 3-2: Non-user benefits and financing water and sanitation services

This study aimed to identify and measure the non-user value associated with improving water and sanitation in informal settlements, and to test the potential impact on raising financing for infrastructure upgrades. Some of the key questions and the approach taken in this study are shown in Table 3-1.

Table 3-1: Research approach

Concept and Research Question	Indicator
Identification of non-user benefits What are the non-user benefits of improving levels of service in informal settlements?	Assessment of awareness of the benefits and the role of water and sanitation in socio-economic development among the non-poor population.
Valuation of non-user benefits What are the social, environmental and socio-economic costs of poor water and sanitation services?	Diarrhoeal infection rates, levels of environmental pollution, health agency cost of treating diarrhoea, work days and school days lost due to diarrhoeal disease.
What are the costs of installation of different service levels?	Cost of construction, operation and maintenance of different levels of service.
What is the value of the non-user benefits of improving levels of service in informal settlements?	Value of public health to businesses, value to tax payers, value of reduction in school absenteeism, value of reduced pollution.
Impact of non-user value Are the quantified values significant to warrant a different outcome if used in resource allocation and planning of water and sanitation services?	Comparison of costs and benefits of level of service interventions.

3.2 Development of survey method

This chapter describes the development of the survey method that was used to identify and measure the non-use value of urban water and sanitation services (Figure 3-3). The method draws on valuation studies in the transportation and environmental sector, in combination with guidelines commonly used for the measurement of willingness to pay in the water sector, and makes adaptations for application in developing countries. In order to allow for context-specific influences during application of the method, this section shall only describe the generic procedures used for the identification of non-user benefits and the designing of survey questionnaires.

3.2.1 Background study

A detailed background study was required to inform the design of the method. Many problems faced with modelling survey data can be avoided by adequate preparation and a meticulous data collection process (Hensher *et al.*, 2005). Empirical literature and expert advice should be used to identify potential sources of non-user benefit. Common indicators of potential benefit are: if the resource is unique and has some heritage or cultural value; if the resource has bequest value; or if the resource has environmental purposes. It should however be noted that many empirical studies do not value non-use benefits (Pearce & Özdemiroglu, 2002). The absence of empirical value estimates however does not indicate absence of non-use value (Pearce & Özdemiroglu, 2002), and an initial study is often required to identify potential sources of value prior to the design of the survey instrument (Humphreys, 2003).A background

study was also required to identify any context-specific issues, e.g. historical and socio-economic factors that could influence the study outcomes (Pearce & Özdemiroglu, 2002).

A desk study was carried out to collect background information on non-user benefits and their valuation. This included compilation of a list of possible benefits from empirical studies, analysis of possible valuation techniques and survey methods, and potential causes of survey biases to avoid during the survey design and implementation. The list of potential benefits was reduced by application of an initial survey that asked respondents to rate the benefits that they most preferred to see.

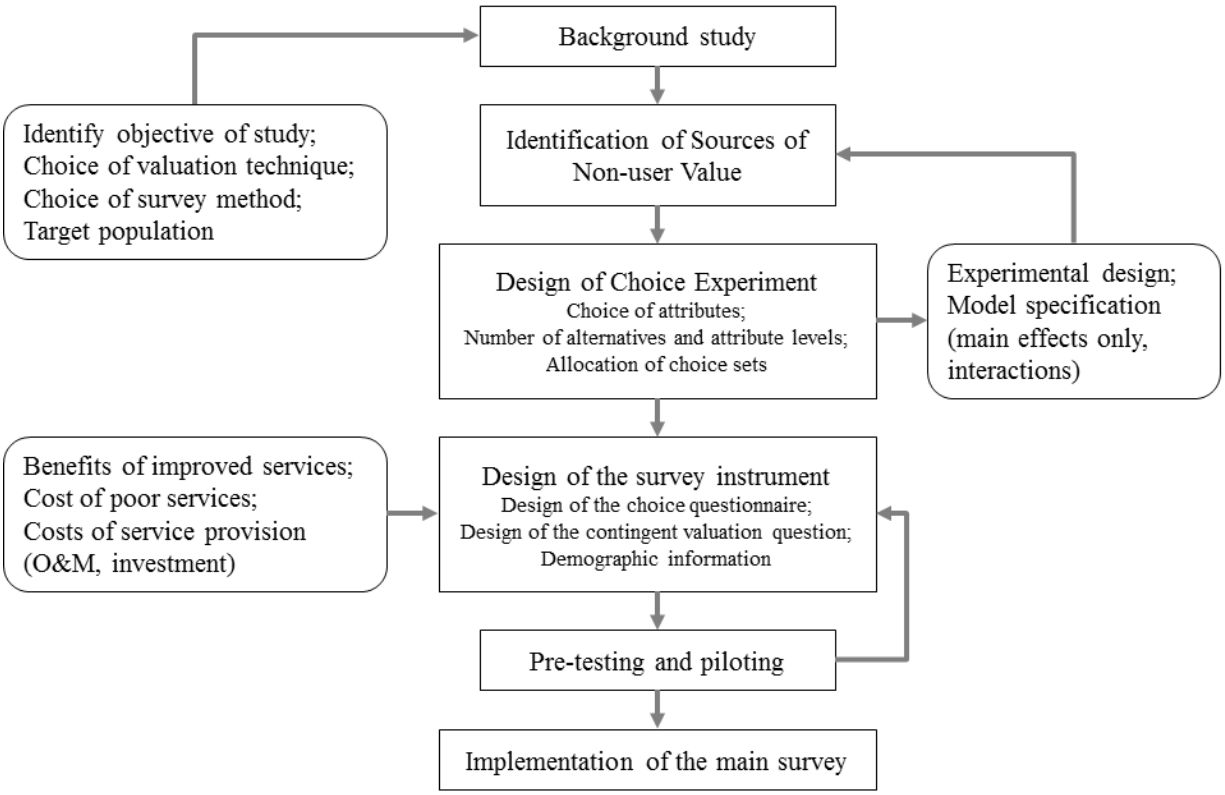

Figure 3-3: Development of survey method

3.2.2 Choice of valuation technique

As discussed in the preceding chapter, stated preference (SP) techniques (i.e. contingent valuation method and choice modelling) are the only suitable means of valuing non-user benefits (Pearce & Özdemiroglu 2002). The choice of SP technique depends on the degree of detail required for the study. Contingent valuation and choice modelling approaches involve asking respondents hypothetical questions about the service under valuation and eliciting their willingness to pay for access to the service. The difference between the two techniques is that contingent valuation questions ask the respondents to state the amount they are willing to pay

(e.g. are you willing to pay X towards accessing the service?) and thus infers value for the service as a whole, while choice modelling infers value from trade-offs made from a combination of attributes of the service under valuation. Choice models provide more detailed information on the resource and its characteristics, and may therefore be more suitable to support management decisions where components of a resource are under discussion, whereas contingent valuation is more suitable where the resource as a whole is under discussion.

In order to maintain the flexibility to measure the willingness to pay and additional factors that may influence the choice outcome, this study opted to use the choice modelling technique. However, as recommended in Pearce & Özdemiroglu (2002), a contingent valuation question was also applied to check for consistency in the choice experiment.

3.2.3 Choice of survey method

The choice of survey method depends largely on the time and budget available for the study (Merino-Castello, 2003).Initial informal interviews can be used to collect and verify information relating to perceptions of benefits and levels of service, e.g. reliability, quantity, quality, cost recovery mechanisms in place, customer service quality, service provider, payment mechanism, cost, etc. This information is important for the accurate description of the service improvements, and thus reduction of biases that sometimes arise from the respondents not fully comprehending the questions or synthesizing their responses (Gutanilake *et al.*, 2007). The data collection technique that is adopted has an impact on the accuracy of results (Young, 2005). Stated Preference researchers generally tend to favour face-to-face interviews because they are flexible and provide an opportunity to clarify questions (Whittington, 1996; Arrow *et al.*, 1993). They also provide more opportunity to control the sample population and result in higher response rates than other survey methods (Gutanilake *et al.*, 2007). Humphreys (2003) and Bristow *et al.* (1991b) used face-to-face interviews with the view that the issues to be considered for measurement of non-use value were too complex for respondents to deal with in a mail-based or telephone survey. However, Whittington (1996) noted that, owing to financial constraints, face to face interviews may not always be possible and other methods such as self-completion questionnaires could then be used, especially where education levels are acceptable.

For this research the decision was taken to test the effectiveness of self-completion questionnaires and face-to-face interviews. Self-completion questionnaires were also tested owing to their potential to reduce expected survey costs.

3.2.4 Target population

The study objectives and the nature of the benefits to be valued can be used to determine the population of interest. Accurate identification of the target population is important for correct aggregation of the survey results (Pearce & Özdemiroglu 2002; Bateman *et al.*, 1999). Other

methods of identifying the population of interest include analysis of maps of the geographical extent of the resource or lists of utility service customers to assess the possible beneficiaries.

A combination of national census and survey data was used to identify the socio-economic brackets that would represent the "non-poor" portion of the population. Geographical maps were used to identify the location of the different socio-economic groups as input to the design of the sampling framework.

3.2.5 Case study selection

African cities are characterised by marked differences in culture, urban development and levels of socio-economic development among others (UN Habitat, 2010). Any study on African cities and recommendations for policy and reform must therefore be context-specific (UN Habitat, 2010). A contextualised study is so-called because it seeks information that is rooted in a social and/or historical context (Flyvbjerg, 2004). This study was well-suited to follow a paradigmatic case study approach because it seeks generalised information towards understanding the contexts and complexities of African cities (Flyvbjerg, 2001). The cities of Kampala, Uganda and Cape Town, South Africa were identified as the case studies because the two cities are primarily different in socio-economic and urban characteristics, and because the researcher had access to both cities. The case studies are discussed in Chapter 4 and Chapter 5.

3.2.6 Sampling framework

The choice of sample size requires a trade-off between cost and precision of sample estimate. This is usually determined by the level of confidence required (a 5% confidence interval is commonly used); the likely response rate; the type of data required (the more substrata, the larger the total sample); and the variance in the target population (larger variances in the population require larger sample sizes). The sample size is also determined by the number of hypothetical scenarios to be described (and therefore the number of parameters to be estimated) and the study budget (Hensher *et al.,* 2005). For choice experiments, the sample size can be reduced since each respondent is presented with multiple alternatives. However when using multi-attribute choice sets as the instrument to estimate WTP, care should be taken to maintain the recommended range of 9 to 15 alternatives per respondent to minimise errors resulting from fatigue (Hensher *et al.*, 2005). According to Hensher *et al.* (2005), the recommended number of respondents per alternative offered should be between 50 and 100.

The sampling method should facilitate the process of identifying the respondents that are representative of the target population (Gutanilake, 2007). Table 3-2 illustrates the various sampling methods available. The probabilistic sampling approach is generally preferred because it is a statistical method and therefore produces a basis for aggregation of the benefits over a larger population (Gutanilake *et al.*, 2007*).*

Table 3-2: Potential sampling methods

Sampling Type	Method	Description
Probabilistic Sampling	Random Sampling	The sample is drawn randomly from the population. Each member of the population has an equal chance of being selected.
	Systematic sampling	The sample is drawn systematically from the population i.e. the n^{th} subject is selected from a random starting point.
	Stratified sampling	The population is divided into divided into strata (should be a true representation of the entire population) and the sample randomly selected from the identified strata. Enables valuation for sub-groups in a population.
	Cluster sampling	The sample is drawn from aggregated geographic groups. Population is divided into clusters from which sample clusters are randomly selected. Attractive for surveys of large populations that possess some sort of hierarchical structure or when no overall sample frame is available.
Non-probabilistic sampling	Convenience sampling	Often used during preliminary or exploratory research. The sample is chosen based on convenience and availability e.g. at a shopping mall or students at a lecture. Not very popular because of failure to generalise.
	Judgement / expert sampling	The sample is selected based on judgment: either for their expertise in the area of investigation or for any other reasons known to the researcher. Ideal for testing a questionnaire.
	Quota sampling	Similar to stratified sampling. The sample is selected from an identified stratum using either convenience or judgement sampling.

(Pearce & Özdemiroglu 2002)

This study presented the respondents with two level-of-service alternatives, implying a range of respondents between 100 and 200. Allowance for a non-response rate of 20% resulted in a sample size of between 120 and 240. In order to reduce survey costs and based on the researcher's knowledge of the target population, a systematic sampling method was proposed for this study. Details of the sampling process will be described during discussion of survey implementation in Chapter 4 and Chapter 5.

3.2.7 Choice of payment mechanism

The payment mechanism describes the way in which the respondent is expected to pay for the good or service. In dealing with unfamiliar goods, the payment mechanism can be a potential source of bias (Gutanilake *et al.*, 2007). The proposed mode of payment should therefore be acceptable and practical to the respondents (Young, 2005). Possible mechanisms through which payment could be collected include:

i. Income tax would be favourable when valuing national goods.

ii. Local Property Taxes are widely used as a means of generating revenue for municipal services.

iii. Utility Bills are an easy means of paying for non-use benefits since they are already an acceptable and easy to understand means of payment for services and the non-users are easily identifiable through municipal records.

iv. A Special Fund could be created with the aim of separating the revenue generated from the mainstream collections. This could serve as a means of confidence building and reducing protests from respondents who may be sceptical about utilisation of the funds.

v. Voluntary donations. Care should however be taken when proposing donations because they are likely to encourage free-riding (i.e. stating a WTP value that is unlikely to be met but sounds good to the respondent).

This research study opted to test the payment through taxes, utility bills and a special fund.

3.2.8 Potential measurement difficulties

Meticulous design of the survey instrument is important if reasonable outcomes are to be realised. In order to avoid errors arising from cognitive limitations, care should be taken to ensure that respondents understand the questions posed. Focus group discussions and pre-tests should be held to test the respondents' ability to assimilate the questions posed and give realistic answers (Pearce & Özdemiroglu, 2002). The three criteria that should be adhered to during design of the survey instrument are summarised as follows:

i. Content Validity: The survey questions should be introduced to the respondents in a clear and unbiased manner so as to encourage truthful and realistic answers. All components of the survey, i.e. the subject under valuation, the proposed changes, and the payment mechanism should aim at encouraging trade-offs between the alternatives, thus eliciting valid value estimates. The experimental design should be checked for extraneous variables that could be confounding and for limitations that are outside the control of the researcher. The internal validity of a design shows the degree to which changes in the dependent variable can be directly attributed to the independent variable. The internal validity of an experiment can be threatened where results are subject to differences in the respondents (selection bias) or an external event influences the experiment. External validity shows the degree to which the study results can be generalized to other people and/or other environments. Threats to external validity can arise where a researcher influences the subject behaviour and where the subjects have already been sensitized by the pre-test and this affects the main survey results (Pearce & Özdemiroglu, 2002).

ii. Theoretical Validity: A good survey should produce data that can be explained by economic theory. Inaccuracies in survey design and use of a wrong methodology could produce results that diverge from the theoretical models (Whittington, 1990).

iii. Predictive Validity: It has been stipulated that SP models alone (without combined RP data) aim more at producing value estimates and explaining data than predicting behaviour,

unless the model is calibrated using alternative specific constants (Pearce & Özdemiroglu, 2002).

The validity issues described above were considered and addressed throughout the process of questionnaire development and implementation. This was done through rigorous testing and constant review of the questionnaire and results. A summary of the biases and the corrective measures is shown in Table 3-3.

3.3 Identification of sources of non-use value

The decision on what attributes to include in the survey and the measurement of the attributes are key steps in the survey design process. Inclusion of ambiguous attributes reduces the ability of the data to explain the variances observed (Hensher *et al.*, 2005), while use of vague units of measurement may render the model difficult to interpret, e.g. a health benefit of improving levels of service could mean a reduction in deaths due to illness by one respondent, but mean a reduction in diarrhoeal infection rate to another respondent. Gutanilake *et al.,* (2007) recommend carrying out initial interviews to provide a better understanding of the WSS conditions and to provide an insight into the cultural, institutional and affordability issues pertaining to the target population.

The influence of the researcher's knowledge of the resource under valuation can play an important role in selecting the attributes (potential changes) that would be of interest to the respondents. In order to ensure that all possible value attributes are explored, a list of benefits was compiled, based on *a priori* judgement and a literature review, and validated using the initial interviews.

The process of identification of sources of value also resulted in a long list of potential attributes. Due to resource and time considerations, it was necessary to narrow down the list of attributes to include in the survey. The initial questionnaire also served to identify the more relevant attributes to include in the survey, and to test the units of measurement that are easily recognised by the respondents. This was done by presenting the respondents with the list of potential attributes and requesting them to rank the attributes that were most applicable to them. An example of the questionnaire is attached in the Appendix A. Details of the application in Kampala and in Cape Town are discussed in Chapter 4 and Chapter 5.

Table 3-3: Corrective measures for potential biases in SP surveys

Description of Bias	Methods to Minimise	Reference
Strategic Bias Deliberate response given with the intention of influencing the outcome for future benefit.	Proper design of questions to include a plausible payment obligation or varying amounts to be paid such that the incentive to overstate WTP equals as far as possible the incentive to understate WTP thus producing	Gutanilake *et al.* (2007). Young (2005). Bristow *et al. (*1991).

Description of Bias	Methods to Minimise	Reference
	an acceptable average. Compare values obtained with values derived through a different technique e.g. alternative cost or with similar services e.g. electricity.	
Compliance Bias Respondents fit their answers to the perceived expectation of the interviewer.	Training and supervision of interviewers.	Young (2005).
Sampling bias The sample may exclude a particular category of the population.	Meticulous preparation and background studies.	Gutanilake *et al.* (2007).
Non neutrality Researcher may influence the response, or the respondents attempt to please.	Enumerator training, extensive pilot testing.	Gutanilake *et al.* (2007).
Non response bias Respondent does not answer the question.	Determination of demographic profile of non-responding population and factoring this into the survey.	Gutanilake *et al.* (2007). Bristow *et al. (*1991). Bateman *et al.* (1999). Mcphail (1993).
Social norm bias Results from pressure exerted on the respondent (knowingly or unknowingly) by people that are important to them or by the interviewer (the interviewer may suggest acceptable answers).	Use of questionnaires eliminates the pressure to conform to social expectations.	Bristow *et al. (*1991).
Information / Interviewer bias Information given to the respondent might bias their response. The interviewer may lead the respondent towards.	Use of questionnaires allows standardised presentation of information.	Bristow *et al. (*1991).
Status Quo bias Arises when the current status and history take importance.	Careful questionnaire design, use of FGDs, extensive pilot testing.	Gutanilake *et al.* (2007). Young (2005).

3.4 Design of the choice experiment

Careful design, piloting and survey implementation is necessary for the production of credible SP results. Advance and meticulous planning of the survey process is required, and adequate time allowed for correcting biases and inconsistencies during piloting (Young, 2005; Pearce & Özdemiroglu 2002).

3.4.1 Experimental design

The aim of an experimental design is to ensure that the data produced can be analysed objectively. Experimental design is also used to organise the attributes into choice sets (the alternative improvement options) that will be presented to the respondents.

3.4.1.1 Choice of attributes and number of alternatives

One condition for the experimental design is that it should be orthogonal, i.e. all attributes must be statistically independent of each other (Hensher *et al.,* 2005). The alternative improvement options should be arranged such that there is no correlation between attributes. One of the challenges in the stated preference surveys is the decision on the number of attributes to include in the choice experiment. An experiment with too many attributes will be costly to implement and may result in measuring variables that are not strongly significant in explaining respondent choice (Merino-Castello, 2003). Experimental designs enable the researcher to reduce the number of irrelevant attributes and keep the survey within the available budget and time constraints. Hensher *et al.* (2005) identify three possible methods of reducing the number of alternatives:

i. Randomly assigning subsets from the list of alternatives to the respondents such that the respondents review a reduced list of alternatives. Although this method is quite thorough and enables testing of the entire list of alternatives, it can be complex to design and expensive to implement, since a large number of respondents is required.
ii. Exclusion of alternatives deemed insignificant to the researcher.
iii. Use of generic alternatives.

The decision on presentation of the choice sets depends on the aim of the valuation study and the preferred model to be estimated. Use of generic alternatives, in which the alternatives are presented based on a description of the attributes is thought to encourage trade-offs based on the characteristics only, while use of labelled alternatives enables more accurate measurement of the contribution of the alternative to the respondent choice, estimated as the Alternative Specific Coefficients (ASCs) (Hensher *et al.,* 2005).

This study adopted the level of service alternatives that were already within the service delivery strategies of the cities of Kampala and Cape Town and tested three improvement options:

i. Provision of communal water and sanitation facilities to the portion of the population that are currently using emergency services.
ii. Provision of shared water and sanitation facilities to the portion of the population that are currently using emergency services and to the portion of the population that are currently using communal facilities.

iii. Provision of yard facilities to the portion of the population that are currently using emergency services and to the portion of the population that are currently using communal and shared facilities.

3.4.1.2 Allocation of choice sets

The attribute levels represent the differences in quality of the attribute under valuation. There should be adequate difference between the attributes such that a trade-off between an improvement or a degradation and cost can be made. In order to test for both linear and non-linear relationships, a minimum of three levels of the attribute is required, which can result in a large combination of attributes, if all possible combinations of attributes are to be tested. In order to keep the experiment practical and to avoid respondent fatigue, it may be necessary to reduce the number of choice sets. The recommended number of choice sets per respondent should be kept to between 9 and 15 pairs (Humphreys, 2003; Pearce & Özdemiroglu, 2002). There are essentially four strategies that can be used to reduce the number of choice sets:

i. Reduce the number of levels used.

ii. Use fractional factorial designs.

iii. Block the design (this involves organising the profiles into smaller blocks to be presented to respondents).

iv. Use a combination of blocked and fractional factorial designs. Fractional factorial designs take a fraction of the experimental design, and can be designed to measure only the main effects (contribution of the main attributes only) or allow for interactions between the attributes. Main effects account for 70% to 90% of unexplained variance in the models (Louviere *et al.,* 2000), and can thus serve as a basis for reducing the number of questions to be asked.

This study used a combination of blocked and factorial designs to reduce the number of choice sets and to maintain the acceptable number of choice sets presented to the respondents to between 9 and 15, as will be described in Chapter 4 and Chapter 5.

3.5 Design of the survey instrument

The survey instrument should be structured in such a manner that it is easy to understand. The questions should be reflective of the actual situation if realistic results are to be realised. The instrument applied in this thesis was structured in three sections, following the general descriptions in Gutanilake *et al.* (2007) and Pearce & Özdemiroglu (2002).

Section I: Introduction

Section I of the questionnaire contained an introduction and an explanation of the background and purpose of the survey. The enumerators were required to introduce themselves and the organisation on whose behalf they were conducting the survey, i.e. the University of Cape Town. Confidence in the organisation is important because the respondents should believe that their responses will contribute to a change. A confidentiality clause was also presented to the respondents, including an assurance that their responses would only be used for academic and research purposes. In order to recruit the respondents, the enumerators were required to explain the criteria for participation and subsequently request the potential respondents' willingness to participate in the survey.

Section II: The main questionnaire

Section II, the main questionnaire, was structured into three parts:

- **Attitudinal questions:** The first part of the questionnaire aimed at investigating the perceptions of the respondents on municipal service delivery. The questions also served to prepare the respondents for the subject matter under study. This was done by including questions relating to non-user benefits among the general attitudinal questions.
- **Choice questions:** Choice modelling is based on the premise that a good or resource can be described in terms of its attributes, e.g. a car can be described in terms of comfort, cost, colour, etc. Different levels of these attributes result in different goods which may change the value or utility derived from the good. By presenting a respondent with attributes at different levels, a choice experiment is able to generate information on the ranking of these attributes, the value of the different attributes and ultimately the total value of the resource (assumed to be the sum of the values of the attributes).The profiles that were constructed in the experimental design were randomly grouped into choice sets and presented to respondents as pairs of alternatives from which to make a choice.
- **CV questions:** In order to check the validity and consistency of the responses from the choice questions, it is sometimes recommended to include a different SP approach in a survey. In constructing a CV question, it is important to describe the "good" under valuation and the expected impact or change from the intervention planned. Poorly described scenarios result in wrong or unrealistic answers. CV questions aim at eliciting maximum willingness to pay or minimum willingness to accept compensation. It is therefore important that the question is correctly posed to elicit the respondents' maximum WTP. A summary of the possible elicitation formats is presented in Table 3-4.

Table 3-4: Possible elicitation formats

Format	Advantages	Disadvantages
Open ended Respondents asked "What is your maximum WTP?"	Is straightforward. Eliminates anchoring bias since does not provide respondents with a cue to what the value of the change might be.	Can result in protest votes and unrealistic answers. Respondents may face difficulty in determining their maximum WTP for a good that they are unfamiliar with.
Bidding game Respondents presented with "Are you willing to pay (a set amount) for a change?" If "yes", the amount is increased until the respondent answers "no". If the respondent answer is "no", the amount is reduced until the respondent answers "yes".	May encourage respondents to think and process their willingness to pay before answering.	Difficult to use in mail and self-completion questionnaires. May encourage unrealistic "yes" answers.
Payment cards Respondents presented with a list of monetary values.	Informative and cheap to implement. Can allow for uncertainty, by stating "Do not know". Avoids starting point bias. Avoids outliers.	Biases could arise resulting from the range of values.
Single bounded dichotomous Also referendum "Would you pay (a set amount) per month for this change?" Respondents say "yes" or "no" to a single WTP amount. **Double bounded dichotomous** Respondents say yes or no to an amount and then asked to say "yes" or "no" to higher and / or lower bids.	Easy for respondent to assimilate. Can allow for uncertainty (either by stating "Do not know" or by crossing out definite value that are not willing to pay for.	Values may not be consistent with values obtained from open-ended. Produces limited information (WTP can only be above or below the stipulated amount. Potential for starting point, anchoring bias.

(Gutanilake *et al.*, 2007; Merino-Castello, 2003)

When posing CV questions, the respondent should understand that the valuation requires a trade-off between their income and the money required for the service (Gutanilake *et al.*, 2007; Whittington, 1996). In this study, the respondents were requested to state a willingness to pay value bearing in mind their household income and expenditure. In order to validate the WTP answers and isolate motives or protests against willingness to pay, the respondents were also requested to state the reasons for their WTP answers.

Section III: Demographic information

The final section of the questionnaire asked for demographic information on the respondents. This information was used to explain respondent answers and to test whether the WTP values conform to theoretical expectations (e.g. whether WTP varies with income)and to test for changes in WTP values with demographic characteristics such as family size, education levels.

3.6 Testing the questionnaire design

Due to the complex nature of valuing non-market goods, it is important that the questionnaire is pre-tested for correct wording, clarity of questions, etc. Pre-testing and piloting the questionnaire prior to its implementation are important steps for the elimination of potential biases and to ensure that the respondents comprehend the subject matter. Pre-testing is normally carried out on a small group after which the questionnaire is revised to incorporate any changes or correct problems that arise. Pre-testing the questionnaire can be done in a focus group discussion conducted between 6 and 12 people to maximise discussion and generation of information (Pearce & Özdemiroglu, 2002). Pilot testing is done on a slightly larger group and aims mainly at checking whether the questionnaire yields the desired results. Iteration between revision and re-testing can be done as many times as necessary to get the required results. A pilot sample is usually done on a slightly larger number – ranging from 25 to 100 randomly selected respondents (Pearce & Özdemiroglu, 2002).

Implementation of the pilot and main survey was carried out by survey consultancy companies who were able to add expertise and advice on methodological issues. In the two cities in which the survey was carried out, the researcher trained the enumerators prior to piloting and implementation. The researcher was also responsible for monitoring and quality control during survey implementation.

3.7 Survey implementation and administration

3.7.1 Sampling strategy

The sampling strategy applied in a survey depends on local conditions, e.g. number of variables to be analysed, socio-economic and geographic profile of the study area, among others (Young, 2005). The sample frame can be determined geographically (all residential households in the city); by using the voters' register of the city; from residents registered in the phone directory; from a list of customers of the utility companies, i.e. water, electricity, etc. Applying some of these methods in developing countries where not all residents are registered in the phone book or registered to vote could however result in sampling biases (Pearce & Özdemiroglu 2002). This study opted to use geographical maps and the customer list of the water utility company in the city of Kampala (described in Chapter 4) and to use geographical maps in the City of Cape Town (described in Chapter 5) as the sample frame.

3.7.2 Choice of respondent

Owing to the difference in characteristics of the stakeholders, the survey could be addressed to different sampling units as follows: to an individual in a household; to an individual on behalf of the household; to the household for a collective valuation (Pearce & Özdemiroglu 2002).

Some of the non-user benefits are felt by adults only (in their capacity as employers and policy makers, as caregivers and as heads of households) while some benefits are felt by children. Due to the complexity of the subject matter, the respondent for this study was taken to be the head of the household. In order to control the sample, careful recruitment of the respondents was done by asking the respondent if they met pre-determined criteria, especially with respect to the income group.

Details of the survey and analysis of the Kampala data are presented in Chapter 4. The survey and analysis of the Cape Town data are presented in Chapter 5.

4. The case of Kampala

The method developed in Chapter 3 was applied in the city of Kampala, Uganda. This chapter discusses the findings of the survey and explores the potential implications of the results on improving water and sanitation services in informal settlements in Kampala.

4.1 Background

The city of Kampala, which covers a geographical span of 200 km^2, is the administrative and commercial centre of the country. The city is divided into five administrative divisions (Figure 4-1) and has an estimated population of 1.7 million with a population growth rate of 4.1% per annum (UBOS, 2010).80% of the city is unplanned, predominantly peri-urban and informal with slum areas that are scattered around the city as shown in Figure 4-1 (KCC, 2008).

Over the past 10 years, Uganda has posted an average Gross Domestic Product (GDP) growth of 5% per annum with per capita gross national income reported at USD 420 compared to an average of USD 1082 gross national income for the sub-Saharan region(for the years 2007-2011) (World Bank, 2012). During the same time, national poverty levels were reported to have increased from 34% to 38%, contributed in part by the rapid increase in urban poverty (World Bank, 2012). Common disease prevalence is 29% for malaria, 14.4% for diarrhoea and 12.1% for HIV/AIDS. The mortality rate for children below 5 years is 129 out of 1000 live births, with the main cause of specific mortality rates attributed to malaria at 15%, diarrheal diseases at 12.3% and HIV/AIDS at 12% (KCC, 2008). 20% of the population is characterized as living below the poverty line. 52.3% of the population lie within the economically active age group (i.e. between 17 to 64 years). However 6.2% of the age group between 5 and 17 years are reported to be working (KCC, 2008). This is also reflected in the school attendance records which show that 10% of the school-age going population is not in school (KCC, 2008).

The Government of Uganda has set stringent targets in its Poverty Eradication Action Plan (PEAP) aimed at reducing child mortality, improving maternal health and improving environmental sustainability (MoWE, 2006). However according to MoWE (2008), there has been little progress in meeting the PEAP targets, primarily due to a lack of political will and lack of recognition among society of the role of water and sanitation in household health and productivity.

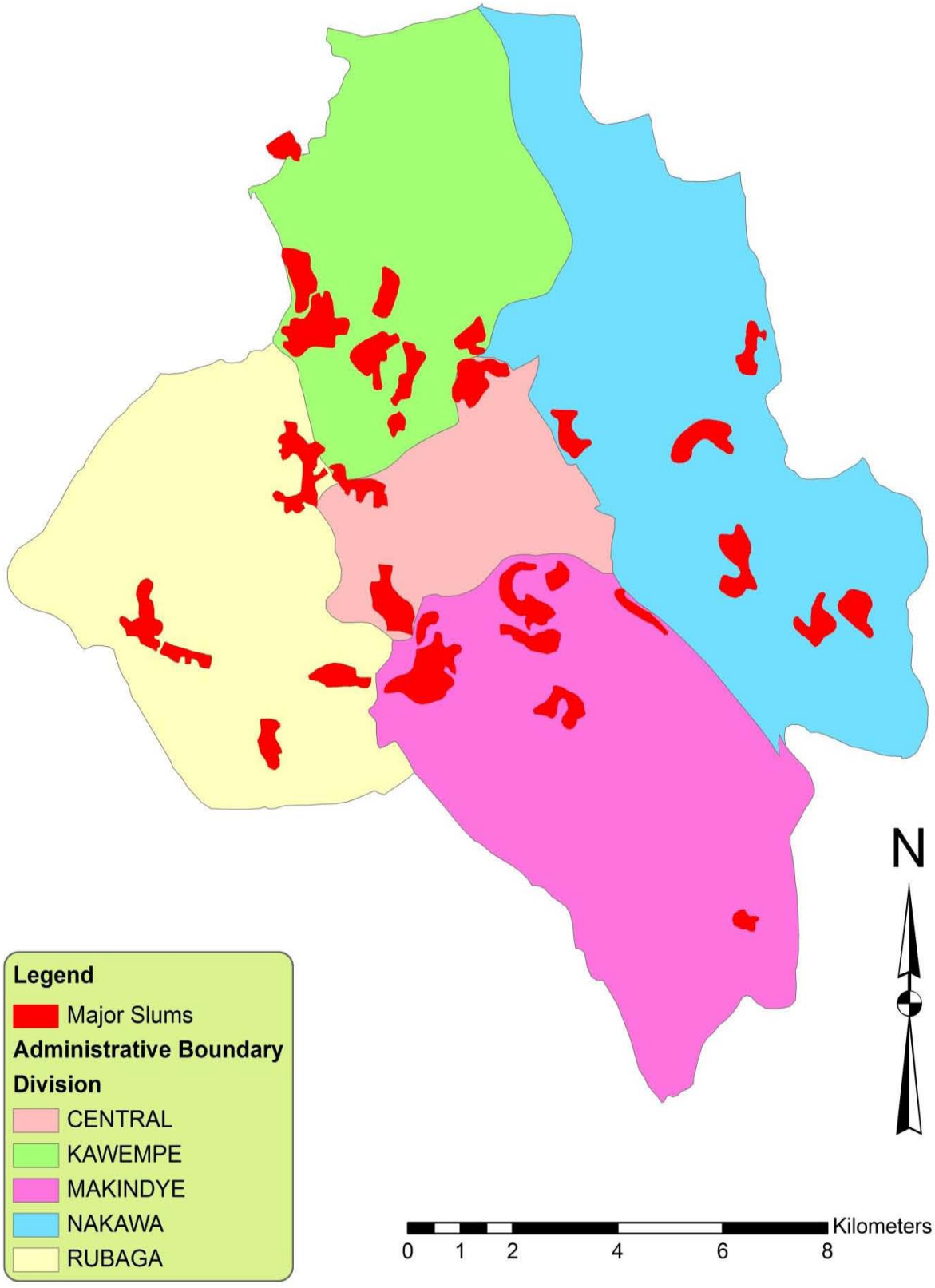

Figure 4-1: Major informal settlements in Kampala
(KCC; 2008)

4.2 Water services in Kampala

4.2.1 Institutional framework of the water and sanitation sector

Development of water resources is anchored in the Constitution of Uganda (1995) which, together with the Uganda Water Action Plan (1995) and the National Water Policy (1999), promotes recognition of the social and economic value of water in the development and management of water resources. The institutional actors in the water and sanitation subsector are the Directorate of Water Development and the Directorate of Water Resources Management who are responsible for policy, regulation and strategic planning of the subsector. The National Water and Sewerage Corporation (NWSC) is responsible for the provision of water and sewerage services while the Kampala City Council is in charge of on-site sanitation (Figure 4-2).

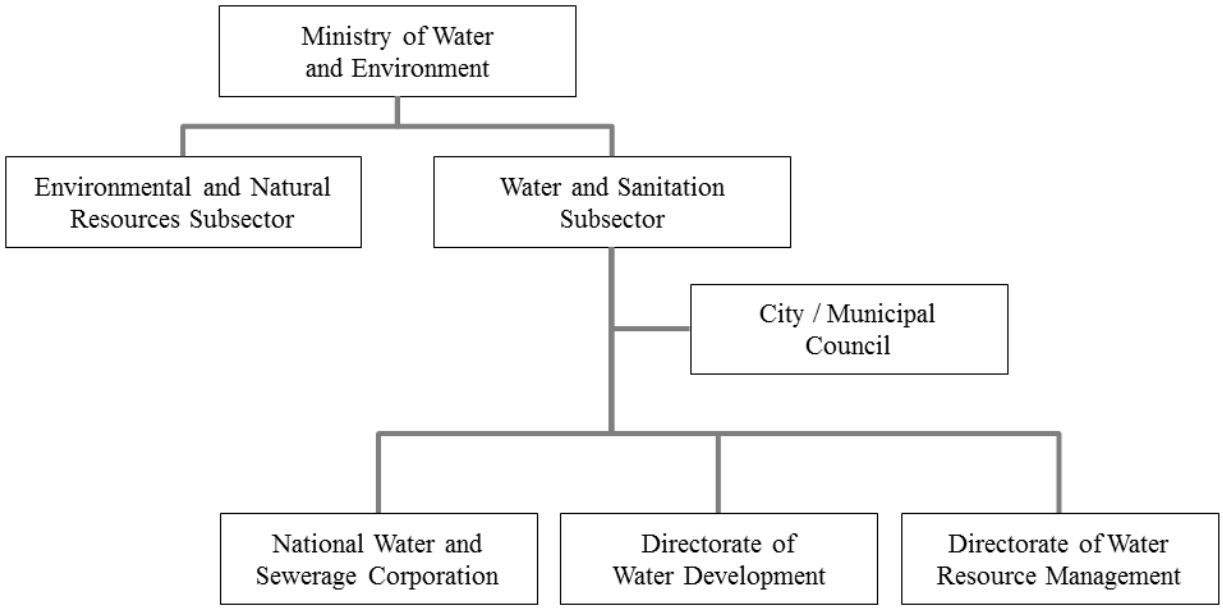

Figure 4-2: Institutional set-up of the urban water sector in Uganda

It is estimated that the NWSC supplies water to over 75% of Kampala's population through in-house connections, yard taps and standpipes (NWSC, 2009). The rest of the population, mostly the poor living in the informal settlements, use water bought from vendors or free water from springs. However, according to the Kampala City Council, over 65% of the springs in the city are contaminated by coliform bacteria (Chemiphar & HSC, 2006). The NWSC is also responsible for the collection, treatment and disposal of sewered sanitation while the Kampala City Council is responsible for on-site sanitation. Sanitation facilities are largely the responsibility of individual households. 24% of the population use a flush toilet (a combination

of sewered and septic tanks), while 70% use pit latrines (many of which are of questionable quality) and 6% have no sanitation facility at all (NWSC, 2009).

4.2.2 Water and sanitation services in Kampala

Prior to 1930, the water supply system in Kampala consisted largely of rain water harvesting, implemented at a household level. This was supplemented in the dry season by ground water, mainly through springs and wells. The sanitary system for the estimated population of 20,000 consisted of a total of 1064 bucket latrines, which were emptied and transported out of the city. The earliest reports of ground water pollution in Kampala date back to 1926 (Nilsson, 2006). The reliance on polluted ground water for domestic water use, coupled with an unsanitary bucket latrine system for the disposal of waste resulted in frequent outbreaks of diseases such as malaria and cholera. Thus in 1930, in response to increasing public health concerns, the protectorate government constructed the city's water supply system targeting mainly the area under British protectorate (Kampala was administratively divided into two areas: one directly under British administration, and one under the administration of the King of Buganda). The water supply system was complemented 10 years later with a sewer and stormwater system, constructed to serve only the CBD and selected parts of the city. During the period of political turmoil that ripped the country apart between 1970 and 1980, much of the physical and institutional infrastructure was either destroyed or neglected (Thomson *et al.*, 2002). There was little input into the maintenance, rehabilitation or expansion of the systems, and as a result, productivity declined and the quality of service deteriorated (NWSC, 2006). The National Water and Sewerage Corporation has since been faced with the challenge of covering the backlog in services while still meeting the demands of a growing population that consists of a large customer base that is largely not able to pay to maintain adequate levels of service (Thomson *et al.*, 2002).

It is estimated that 40% of the urban population in Kampala live in over 23 informal settlements scattered around the city (KCC, 2008). The state of inadequate housing and poor water and sanitation in informal settlements in Kampala is caused in part by a land tenure system that does not encourage infrastructure development (UN-Habitat, 2007). Most of the informal settlements in the city are situated on either private ("mailo") land which belongs to private land owners or on freehold land which is occupied by tenants that have a customary claim to the land. The Kampala City Council does not have a statutory mandate to enforce planning regulations over "mailo" and freehold land, and as a result landlords are not given adequate incentives to improve the living conditions in informal settlements (UN-Habitat 2007; KCC, 2002). Where provided, water supply is *via* communal standpipes and to a lesser extent through yard taps (NWSC, 2008). The unserved portion of the population gets access to water from vendors who sell water at relatively high prices e.g. a study carried out in 2003 found that the poor in informal settlements pay between 2 and 12 times the domestic tariff (GKW Consult *et al.*, 2003), or they opt to fetch "free" water from springs, which are often contaminated (Chemiphar & HSC, 2006). The responsibility for providing sanitation in Uganda is at

household level. The absence of adequate enforcement by the local authority has resulted in a situation in which landlords in the informal settlements provide the lowest levels of service, often delivering poorly constructed and poorly maintained facilities (UN-Habitat, 2007; Chemiphar & HSC, 2006). Achieving the Government of Uganda (GoU)target of 100% access of safe water and adequate sanitation by the year 2015 will require an estimated investment of 75 billion UGX (2010 USD 45 million) a year to expand and maintain water supply and sanitation (PEM Consult & SEREFACO, 2008)

The NWSC finances its operational costs and to a limited extent, its investment costs, through user tariffs charged to its customers (Muhairwe, 2007; Isingoma, 2005). The average tariff of 1561 UGX (2010 USD, 0.93) per cubic metre against an average cost of production of 1250 UGX (2010 USD, 0.74) per cubic metre of water implies that NWSC can just afford its operational costs and posts an operating profit of 311 UGX (2010 USD, 0.19) per cubic metre (NWSC, 2008). At an average per capita cost of investment in Kampala of 26,000 UGX (2010 USD, 15.5) per year (PEM Consult & SEREFACO, 2008), the utility company cannot afford to finance its capital investments and must look to either improving its revenue base or continuing to rely on external aid to finance its expansion programs (Muhairwe, 2007).

4.2.2.1 Financing urban water and sanitation in Kampala: an Overview

The first water and sanitation policies in Kampala were put in place to manage payment for the regular emptying of the bucket latrines in the 1930s (Nilsson, 2006a). Under the Buganda Township Sanitary Law of 1931, payment for the management of the bucket latrine system was charged to each household through a fee levied by the town authority. The centralised water supply system was constructed using financing from the international capital market with financial guarantees from the British government and serviced by user charges through a combination of a special property tax and volumetric user charges (Nilsson, 2006a). The sewerage system was financed under a general tax, and further subsidised by the government (Nilsson, 2006). Although the water supply system was designed to be self-sustaining, the policies put in place to manage it were detrimental to future growth. The policy promoted operation of the system on a non-profit basis and any surplus revenue was used to reduce rates, implying little opportunity to use the revenue for expansion of the system. The sewerage system was considered a public service and thus paid for through a general tax and supplemented by public subsidy. Furthermore, the services were designed based on the needs of the high income population and not all the beneficiaries. The level of public participation was also low; decisions were made by the administrative government with little consultation with the local populace. It is reported that the operational cost of the centralised sewerage system was five times that of the bucket latrine system (Nilsson, 2006a). There was no expectation of cost recovery from the users since the sewerage system was subsidised, being paid for through a central tax system. Moreover, there was no consideration of affordability of the local population; by 1939 the recurrent per capita expenditure on the sewerage system was

about 35 UGX per month, compared to an average income of between 8 UGX and 11 UGX per month for a low skilled worker in Kampala (Nilsson, 2006a:381).

In order to improve efficiency of service delivery, the water authority embraced policies that aimed to increase the role of the private sector in the delivery of public services and, in the 2000s, embarked on a reform process to streamline efforts to improve service delivery. Under these reforms, the central government was to maintain a central role of service delivery and would be responsible for the planning of investments in the water sector(MoWE, 2008). In recognition of the challenge of trying to provide everyone with a high level of service, the policy recommendation was to operate under the principle of "Some for all, rather than all for some", recommending a tariff framework that was affordable and beneficial to the poor (MoWE, 2008). On the other hand, the policy guidelines also aimed to achieve sustainability through reduction of public subsidies (MoWE, 2008).In 2006, none of the water service areas managed by the NWSC met their capital budgets and only three of the larger urban centres were able to meet their full operational requirements (WSP-Africa, 2006). The smaller towns operated on large deficits (the average cost of water treatment and supply in the small towns was three times that of larger towns), and were subsidised by the larger towns (WSP-Africa, 2006). In order to meet the policy objectives and achieve access of water services to all, the water sector performance report of 2008 highlighted the deficiency in financing and called for new avenues to finance the water sector (MoWE, 2008). The NWSC investment plan of 2008 recommended a financing solution that combines loan and grant financing with low tariff increases (PEM Consult & SEREFACO, 2008). This however still requires a minimum level of cost recovery for meeting loan repayments. Considerations for the poor make it difficult to achieve cost recovery through user charges (McDonald, 2002). Leveraging financing through co-financing methods may therefore provide a socially acceptable investment plan while still increasing the levels of cost recovery (PEM Consult & SEREFACO, 2008).

4.3 Survey method

As described in Chapter 3, the survey approach involved the design of a choice experiment, followed by a contingent valuation question to validate the choice experiment responses. The choice experiment was designed over an eight month period which involved implementation of informal interviews to identify sources of non-use value and to test the possible value attributes to be used in the survey, the design of the SP questionnaire, pre-testing and piloting to ascertain comprehensive wording of the questionnaire, and final implementation.

The following section discusses the rationale of the choices made with respect to the elicitation method, interview format and sampling frame. The structure of the questionnaire is also discussed in detail.

4.3.1 Background study

4.3.1.1 Target population

The purpose of the study is to determine the value to the more affluent residents of Kampala of improving levels of services in informal settlements. The Uganda household survey data (UNHS, 2006) was used to identify the boundaries of the population (based on income levels) used in the survey. The target population was thus identified as the "non-poor" residents of the city that do not live in informal settlements and whose household income is above 100,000 UGX (2010 USD, 60) per month.

4.3.1.2 Choice of valuation technique

Stated Preference survey methods were the valuation technique favoured for this study. In order to check for consistency in responses and eliminate biases that result from describing hypothetical scenarios, two valuation techniques were applied. A choice experiment was used to elicit willingness to pay and a contingent valuation question was included to validate the responses from the choice experiment. Due to financial constraints relating to the requirements for development and application of a full CV questionnaire, and since the purpose of the CV question was to validate the willingness to pay estimate from the choice experiment, this study opted to apply a payment ladder to elicit the CV estimates.

4.3.1.3 Choice of elicitation format

Informal interviews were used in the first phase of data collection to collect information relating to perceptions of benefits and levels of service such as reliability, quantity, quality, customer service, service provider, payment mechanism, etc. This information was collected using self-completion questionnaires distributed using the snowball sampling method. The findings of this phase were used as input to the design of the main questionnaire and served to enhance the description of the service improvements, and thus reduce cognitive bias that sometimes arises from the respondents not fully comprehending the questions or synthesizing their responses (Gutanilake *et al.*, 2007). For the main survey, two elicitation methods were tested, namely face-to-face interviews and self-completion questionnaires.

4.3.1.4 Level of service options

The decision on what improvement options to include in the survey was based on *a priori* knowledge of the physical and special limitations of the informal settlements, and on the service delivery plans of the water utility company (NWSC, 2008). Three improvement options were presented to the respondents:

i. One tap for every 200 people (40 households) and communal Ventilated Improved Pit (VIP) latrine. For the rest of this chapter, this level of service shall be referred to as communal facilities.

ii. One yard tap and a flush toilet shared between every seven households. For the rest of this chapter, this level of service shall be referred to as shared facilities.

iii. One tap and a flush toilet in the household yard. For the rest of this chapter, this level of service shall be referred to as yard facilities.

4.3.2 Identification of value attributes

The attributes were identified based on *a priori* judgement and a review of various studies. In order to ensure that all possible value attributes were explored, a list of benefits was compiled and validated by asking 50 respondents (sampled using the snowball technique), to rank the benefits that they felt were most important to them. The snowball sampling technique involved asking a selection of acquaintances to fill out the questionnaire and to send the questionnaire on to their acquaintances. This sampling technique was useful as an initial data collection method because it was cheap (the questionnaires were sent out by email), and allowed for informal discussion of the non-user benefits that could potentially influence the study.

The respondents were presented with a list of the potential benefits that occur when water services are improved, and were requested to rank the first and second most preferred benefits that they would like to see. This process was useful in narrowing down the list of possible variables and in ensuring that relevant variables were applied to the survey. The attributes adopted for the experimental design were chosen based on the benefits assigned by the respondents as the benefit that they most preferred to see from improving water services. The attributes tested were grouped into health, social, environmental and economic benefits, as described below.

4.3.2.1 Health benefits

The list of potential health benefits included a reduction in child mortality due to diarrhoeal disease, a reduction in diarrhoeal infection among children, and a reduction in infection of water-borne disease, as illustrated in Figure 4-3. 64% of the respondents stated that they most preferred to see a reduction in the number of infections from diarrhoeal and intestinal disease compared to the 32% who most preferred to see a reduction in child mortality due to diarrhoeal disease. Reduction in child mortality due to diarrhoeal disease was however the highest among the second most preferred benefit, having been chosen by 50% of the respondents.

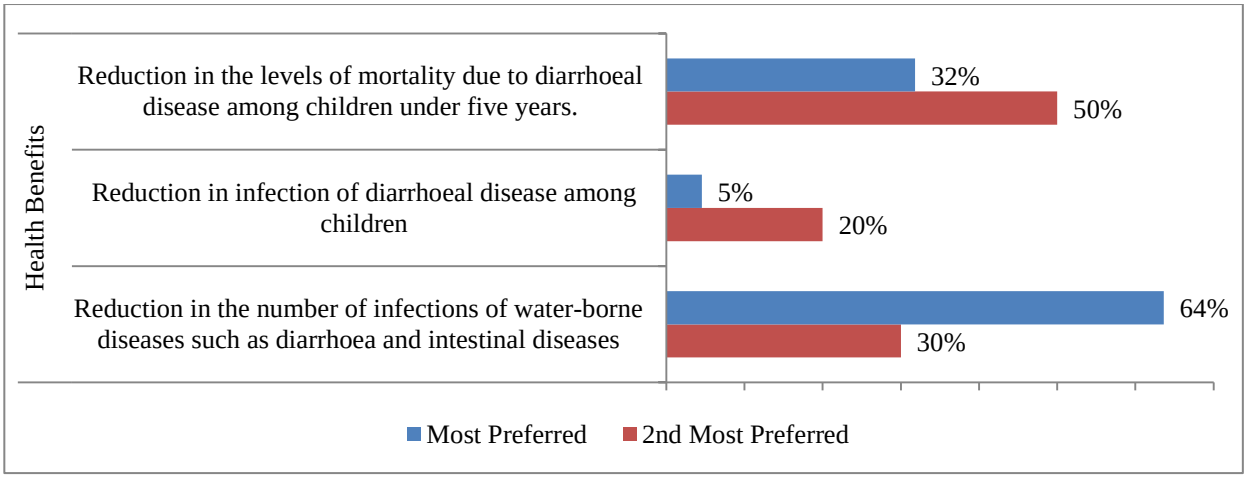

Figure 4-3: Cognition of potential health benefits (n=55)

The indicator of potential health benefits adopted for the survey was described as the reduction in diarrhoeal infections per month, and was based on the number of diarrhoeal infections reported at health centres in the city. Based on findings by Schnabel (2009) and Tumwine *et al.* (2002), the diarrhoeal incidences (per 100 households per month) for households with different levels of service were identified (Table 4-1). There was no difference between the reported cases associated with shared facilities and the number of diarrhoeal cases associated with yard facilities. Studies have found that most health benefits are realised from improving the lowest levels of service (Hutton & Haller, 2004).

Table 4-1: Diarrhoeal incidences originating from the different levels of service

Level of Service	Incidence / 100 people / month
Communal Facilities	60
Shared Facilities	20
Yard facilities	20
In-house facilities	8

(Schnabel, 2009; Tumwine *et al.*, 2002)

4.3.2.2 Economic benefits

The potential benefits from having facilities brought closer to the household were tested. The time savings tested were the reduction in absenteeism from school due to diarrhoeal illness, the reduction in absenteeism from work among adults that are taking care of sick children, and the reduction in absenteeism from work among sick adults (see Figure 4-4). Reduction in the number of days that sick children are absent from school scored the highest, being chosen by 57% of the respondents as the most preferred indicator and 38% of the respondents as the 2nd most preferred indicator for socio-economic benefit.

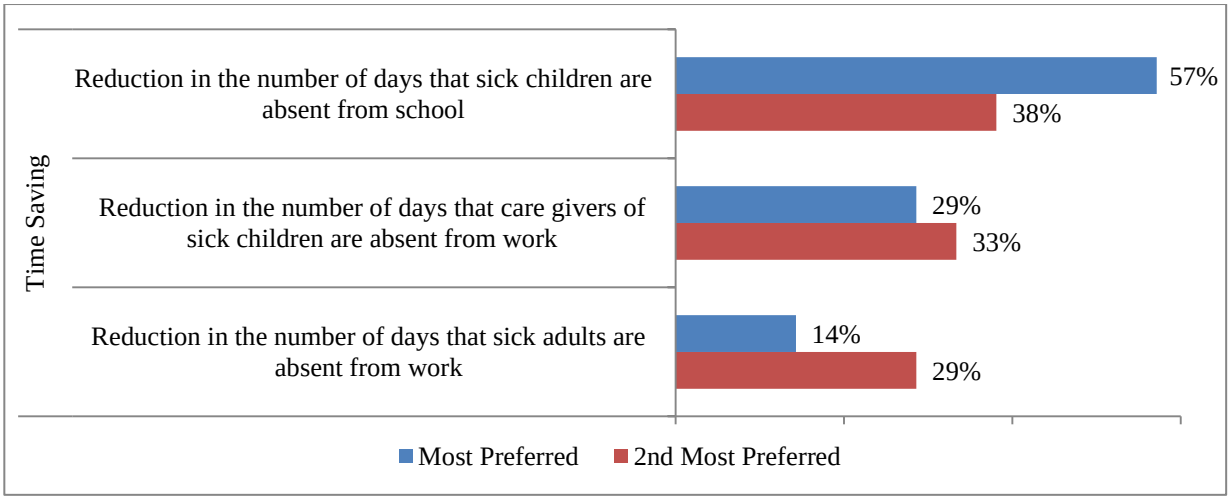

Figure 4-4: Preference for time saving benefits (n=55)

The time savings adapted for this study were therefore described as the number of school days saved by bringing water and sanitation facilities closer to the households. The time lost due to illness among children of school going age, i.e. between five years and 16 years, was determined using information from the demographic health surveys (UBOS, 2007). According to UBOS (2007), the average number of school days lost due to diarrhoeal disease (in urban areas) is 4.6 days/ 100 children / month. This study assumed that the distribution of school days lost would be in proportion to the diarrhoeal incidences that originated from the different levels of level of service, and applied the percent distribution of diarrhoeal incidences to determine the school days lost among children at each level of service (see Table 4-2).

Table 4-2: Estimated number of school days lost due to diarrhoeal disease

Level of Service	Proportion of total diarrhoeal incidences	School days lost per month (No. /100 children)
Communal Facilities	56%	2.5
Shared Facilities	19%	0.9
Yard Facilities	19%	0.9
In-house facilities	7%	0.3

Source: (UBOS, 2007)

The list of potential financial savings from improved levels of service included the reduction in production costs to businesses, the reduction in labour costs due to reduced absenteeism from work, the reduction in health insurance costs for employees, and the reduction in tax money spent on treatment of diarrhoea in health centres (see Figure 4-5).

The benefit that the respondents most preferred to see was the reduction in tax money spent on treatment of diarrhoea in health centres, chosen by 60% of the respondents, followed

by an increase in labour productivity due to reduced absenteeism from work, chosen by 30% of the respondents.

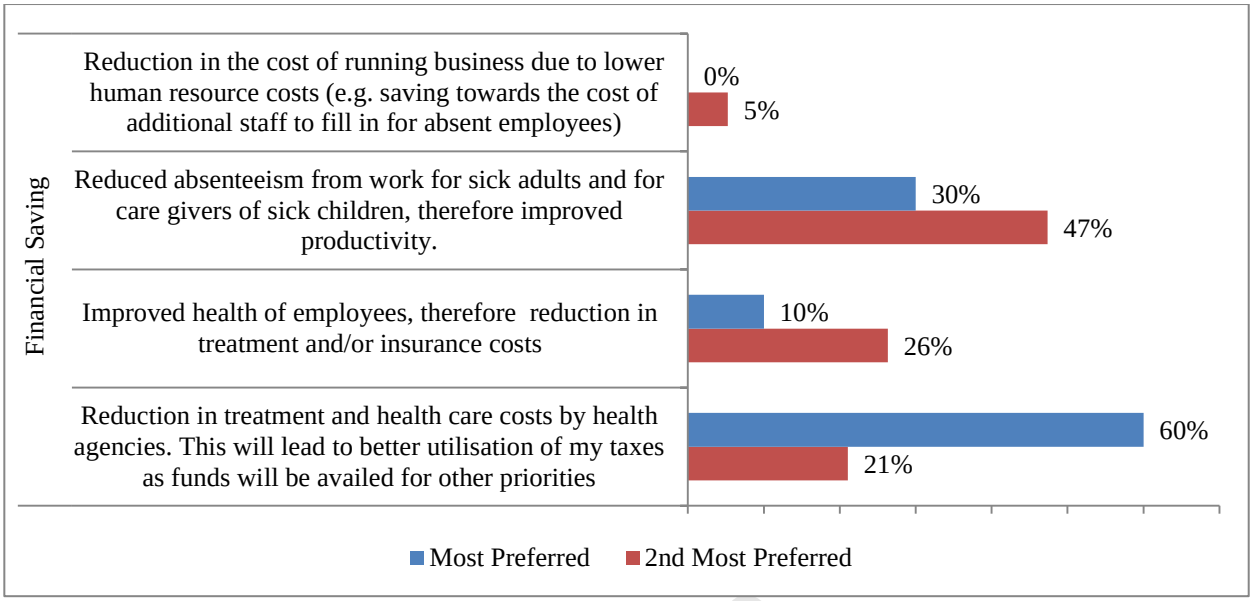

Figure 4-5: Ranking of financial benefits

According to the demographic health surveys (UBOS, 2007), 67.5% of diarrhoeal incidences receive treatment at health centres. The average number of diarrhoeal cases reported at health centres is 2.1 /incidence/ year, at an average cost of treatment of 28,000 UGX per case, including consultation and transport costs (Schnabel, 2009; UBOS, 2007). Based on an average household size of five, a total population of two million people, and on a population of 296,000 households that are connected to the water supply network, the average monthly health agency cost of diarrhoea is 2682 UGX toward each household depending on communal facilities; and 894 UGX toward each household depending on shared and yard facilities (Table 4-3).

Table 4-3: Health agency cost of diarrhoeal disease

Level of service	Diarrhoeal Incidences that sought treatment (No. / 100 people)	Cost per incidence (UGX / 100 people / year)	Total health cost (UGX / household / month)
Communal Facilities	40.5	2,381,400	2,682
Shared Facilities	13.5	793,800	894
Yard Facilities	13.5	793,800	894

4.3.2.3 Environmental benefits

The list of potential environmental benefits included improvement in the aesthetic quality of informal settlements, reduction of pollution (thus preservation of water resources for future generations), and reduction in tax money spent on environmental clean-ups as illustrated in Figure 4-6. 46% of the respondents stated that their most preferred indicator for environmental benefit was a reduction in pollution of water courses for use by future generations. This was also the highest score as the 2nd most preferred indicator. The indicator for environmental benefit adopted for the survey was therefore the reduction in pollution of water courses.

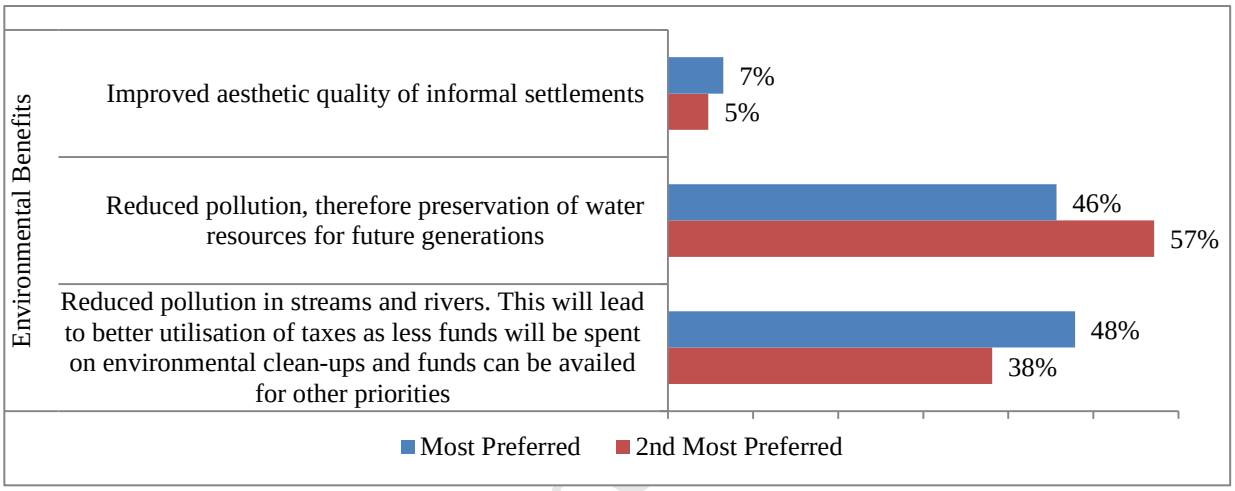

Figure 4-6: Preference for environmental benefits

Many of the informal settlements in Kampala are situated in the valleys and low lying parts of the city, and thus surrounded by springs that originate from the hilltops. Reports from the Kampala City Council (KCC, 2007) indicated that 9 out of 10 springs were polluted and unfit for human consumption. This study assumed that the level of environmental pollution would reduce by half as the level of service improved (i.e. the number of springs (out of 100 springs) that will comply with drinking water quality standards is 60, 30 and 10 for yard, shared and communal facilities respectively).

4.3.2.4 Social benefits

The respondents were presented with the following potential social benefits: gender-related concerns with respect to reducing the burden of fetching water by women and children; concern over the risk of disease outbreaks; concern for social equity; and concern for living conditions of friends, family and vulnerable members of society that live in informal settlements. As illustrated in Figure 4-7, the respondents were most concerned about social equity, but were also highly concerned with improving levels of service for the sick and elderly and reducing burden of fetching water from children.

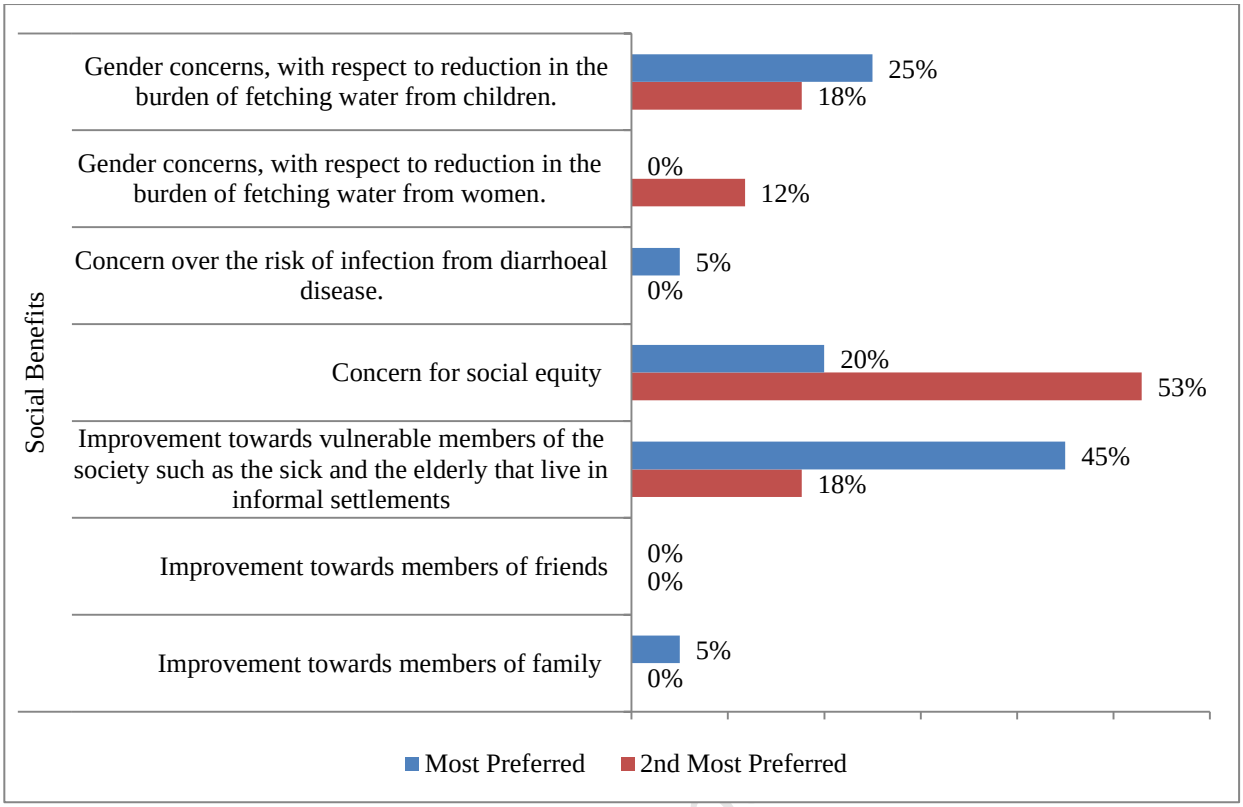

Figure 4-7: Preference for social benefits

Due to difficulties in qualifying the components, the social benefits were not included in the choice model.

4.3.2.5 Payment mechanism

The payment mechanism describes the way in which the respondent is expected to pay for the good. The following options for payment were presented to the respondents:

i. Central government taxes: have the advantage of being an already established system and may therefore be easily recognised by the respondents.

ii. Utility bills: are already an acceptable means of payment for water and sanitation services and the non-users are easily identifiable through the water utility customer records.

iii. A special fund: that separates the payments collected for the proposed improvements from other revenue collected by the NWSC.

4.3.2.6 The cost of intervention

The annualised capital and maintenance cost of providing each level of service was calculated as shown in Table 4-4. The unit costs were adopted from NWSC (2007), annualised over the 20 year design life of the intervention at a discount rate of 8% and adjusted to costs in the year

2008 using a PPI index (MoFPED, 2008). The total price per paying household was calculated based on a beneficiary population of 104,000 households (for communal facilities) and 114,064 households (for shared and yard facilities) and a paying population of 296,000 households. Details of the inputs to the tables are shown in the Appendix D.

Table 4-4: Calculation of annualised costs (UGX, 2008)

	Communal Facilities	Shared Facilities	Yard Facilities
Benefiting population (No. of households)	104,000	114,064	114,064
Annualised Capital and O&M Cost per facility (UGX / household / year)	139,557	207,742	359,910
Total Capital and O&M Costs (UGX / year)	14,513,928,000	23,695,883,488	41,052,774,240
Total Monthly Cost (UGX / month)	1,209 494,000	1,974,656, 957	3,421,064,520

A summary of the attributes and units of measurement used in the survey are outlined in Table 4-5.

Table 4-5: Attributes used in the survey

Attribute	Unit of Measurement			
Level of Service	The location of the water and sanitation facilities	Communal Facilities	Shared Facilities	Yard Facilities
Health Cost	The number of diarrhoeal cases reported (No. / 100 people / month	60	20	20
Social / Economic Cost	The number of absent school days lost (No. / 100 children / month	2.5	0.9	0.9
Environmental cost	The number of springs that comply with drinking water quality standards (No. / 100)	10%	30%	60%
Economic Cost	The average amount of tax money spent by health agencies and by households on treatment of diarrhoea (UGX / month)	2682	894	894
Price of Intervention	Additional amount of money required from the respondent's household to install and maintain this level of service (UGX /month)	2500	5000	10000

4.3.3 Experimental design

One of the assumptions of the multinomial logit model is the independence of attributes. Attribute levels are used to represent the changes in quality of the attribute under valuation. Independence of attributes means that it should be possible to isolate each attribute level, e.g.

there should be no statistical correlation between the attribute levels used in the survey. The experimental design varies the combinations of attribute levels in the choice set in a manner such that correlation between the attribute levels is minimised. Therefore the higher the number of levels, the larger the experiment required to test the attribute combinations. Due to resource constraints, this study chose to limit the number of levels of some attributes and used three levels for three of the attributes (as shown in Figure 4-6) and two levels – a higher and lower level – for five of the attributes (as shown in Table 4-7).

Table 4-6: Three level attributes used in the survey

Attribute	Unit of Measurement	Levels		
Level of Service	The location of the water and sanitation facilities	Communal tap & VIP latrines	Tap & flush toilet shared among seven households	Tap & flush toilet in the yard
Effect of distance	Location of the informal settlement to be improved relative to the respondent's household.	Near the respondent's neighbourhood	In another division of Kampala	In another district in Uganda
Payment vehicle	The means through which payment may be collected	Water bill	Central government taxes	Dedicated fund

Table 4-7: Two-level attributes used in the survey

Attribute	Unit of Measurement	Communal Facilities		Shared Facilities		Yard Facilities	
		Low	High	Low	High	Low	High
Health Cost	Number of diarrhoeal cases reported out of 100 people every month	48	72	24	36	12	18
Economic Cost	Number of school days lost among 100 children every month	2	3	1	2	0	1
Environmental cost	Number of springs that do not comply with drinking water quality standards (out of 100)	6	10	3	5	0.8	1.2
Economic Cost	Average tax money spent by health agencies and by households on treatment of diarrhoea(UGX per paying household per month)	2000	3000	800	1200	400	600
Price of Intervention	Installation & maintenance cost for this level of service (UGX per paying household per month)	2000	3000	4000	6000	8000	12000

Having three attributes at three levels and five attributes at two levels implies that a total of 864 i.e. (2^5x3^3) choice sets would be required to test all possible treatment combinations (main

effects and interaction effects between attributes); too many for an individual to assimilate. For practical reasons therefore, a fractional factorial (consisting of a subset of the full treatment combinations) design was adopted from Kocur *et al.* (1982). The fractional design allowed for only the testing of main effects with no interactions between attributes, which reduced the combinations to 16 choice sets (i.e. 2% of the total possible combinations).Testing for main effects only also has the added advantage of saving time and survey costs by reducing the number of questions to be asked. Moreover it has been found that main effects explain between 70% and 90% of the variability in behavioural choices (Hensher *et al.*, 2005).The designs from Kocur *et al.* (1982) satisfy the requirements for a discrete choice model, i.e. are orthogonal, which means that all attributes are statistically independent of each other and the attribute levels display no correlations. In order to avoid respondent fatigue, the experiment of 16 profiles was divided into two choice sets of eight pairs and each respondent was presented with only eight choice sets, which is well within the recommended range of 9 and 15 choices (Humphreys, 2003).

4.3.4 Description of the survey instrument

An example of the survey instrument used in Kampala is included in Appendix B. The survey instrument was divided into three sections as described in Chapter 3.

i. Section I: the recruitment and introduction section that explained the purpose of the survey and checked that the potential respondent met the survey respondent criteria, i.e. the respondent does not live in an informal settlement and has a monthly household income that is above UGX 100,000.

ii. Section II: the main questionnaire which was structured in three parts:

- An attitudes and perceptions section that was aimed at determining the relative importance and the level of customer satisfaction with municipal services. This section also included particular questions on service delivery to the informal settlements that were aimed at identifying the importance of non-user benefits in comparison to user benefits. These questions also served to prepare the respondents for the subsequent questions on non-user benefits.
- The choice experiment which involved presentation of the eight choice pairs from which the respondents were requested to make a choice.
- A contingent valuation question asking the respondents to state their preferred level of service improvement and the maximum amount of money they would be willing to pay for its implementation. The CV question was followed by a question asking the respondents to state the reasons for their answers.

iii. Section III collecting demographic information (age, gender, education level, household expenditure, etc.) on the respondents.

4.4 Survey administration

4.4.1 Sampling strategy

In order to identify a sample population that is representative of the target population, the correct sampling strategy must be applied. In a choice experiment with two alternatives, the recommended number of respondents per alternative should fall within the range of 50 to 100 in number (Hensher *et al.*, 2005). Allowing for a non-response rate of 20% suggests that a minimum range of 60 to 120 would be required for each alternative. Based on data from UNHS (2006), the sample was divided into two income strata:

- A middle income group, represented by respondents whose household expenditure lies between 100,000 UGX and 850,000 UGX per month.
- A high income group, represented by respondents whose household expenditure lies above UGX 850,000 per month.

The customer database of the national water utility was used as the basis of the sample frame. As shown in Table 4-8, the respondents were randomly selected from three of the five administrative divisions of Kampala city, *viz* Central, Makindye and Nakawa divisions. A systematic sampling approach was followed. This involved choosing the n^{th} household from the NWSC customer list, where n is the total number of households in the area divided by 90.

Table 4-8: Number of interviews in each division

Division	Expenditure per gender (UGX)				Total
	Male		Female		
	100,000-340000	Above 340,000	100,000-340,000	Above 340,000	
Nakawa	16	56	34	27	133
Central	8	24	9	25	66
Makindye	8	35	18	40	101
Total	**32**	**115**	**61**	**92**	**300**

4.4.2 Pre-testing and implementation

A social survey consultancy firm was employed to carry out the survey. Although the company had no previous experience carrying out SP surveys, they had extensive experience carrying out willingness to pay studies in the water sector in the study area. In a training session, eight interviewers answered the questionnaire and carried out a practice session amongst each other. This enabled further refining and clarification of the questionnaire wording prior to pre-testing. Due to the extensive initial interviews that had been undertaken during the initial phase of the study, the pre-testing was only carried out on a small number of respondents (n=4). The

purpose of this exercise was to test that the questionnaire was constructed in a clear and coherent manner.

The pilot testing was done on a slightly larger group (n=25) and was aimed mainly at checking whether the respondents were able to complete the questionnaire and whether the interview could be conducted within a time interval that was acceptable to the respondents. Piloting also tested two survey methods: self-completion questionnaires and face-to-face interviews. The self-completion questionnaires had a 30% response rate compared to a 60% response rate using face-to-face interviews. Face-to-face interviews were therefore selected as the implementation method for the main survey. Given that the respondents were randomly chosen and not given an introductory letter, a 60% response rate was considered acceptable enough to proceed to the main survey. Furthermore, face-to-face interviews provided some benefits to the survey process; they allowed for sensitization and clarification of issues to respondents and provided instant feedback to the survey process. The wording of some of the questions was changed to give context and to include more socially acceptable terminology, e.g. addressing the beneficiaries as "residents of informal settlements" and not "the poor". It was also found that respondents were not willing to divulge their income levels, but were more open to discussing their household expenditure. According to UNHS (2006), the average monthly household expenditure of 375,000 UGX is about 95% of the household income (applying a growth rate of 4.2% per annum from 2005 to 2008). It was therefore decided to use household expenditure as a proxy for income. The respondents were then categorised into three expenditure brackets to distinguish between the lower middle (with a monthly household expenditure between 100,000 UGX and 340,000 UGX), middle income (with a monthly household expenditure between 340,000 UGX and 850,000 UGX), and high income group (with a monthly household expenditure between above 850,000 UGX). The survey was conducted between from May to July 2010

4.5 Results

A total of 300 respondents were interviewed from three administrative divisions of Kampala. An introductory phone call was made to the potential respondents requesting their participation and to set up appointments. This approach had a fairly successful response rate of 80%. Unsuccessful attempts were attributed to cases where the utility database was outdated, e.g. the registered telephone number was no longer in use; the potential respondent had relocated to a residence outside the target areas; and where the potential respondent rejected the invitation to participate due to time constraints. Table 4-9 summarises the social-demographic characteristics of the respondents.

Table 4-9: Socio-demographic characteristics of sample respondents

Total number in sample		300
Age	Between age 21 and 69	94.3%
	Above the age of 69	5.7%
Gender	Male	51.3%
Employment Status	Employed or self employed	81.7%
	Pensioners	7.3%
	Other (housewives, students)	8.0%
Education Level	Tertiary education	54.7%
	Certificate of education	
Major income earners of the household		62%
Average household size		6
Average number of minors in the household		3
Average distance from household to nearest informal settlement (km)		0.24
Members of household interested in social and environmental affairs		74%
Monthly household expenditure	Between UGX 100,000-340,000	30%
	Between UGX 340,000-850,000	61%
	Above UGX 850,000	9%

4.5.1 Attitudes and perceptions

4.5.1.1 Importance of municipal objectives

The respondents were asked to rate the importance of a range of municipal objectives. As illustrated in Table 4-10, improving services to the respondents' homes was given the highest importance by 69% of the respondents, followed closely by improving security at 58%. However, when the very important and important ratings are combined, improving security is rated highest by 92% of the respondents, followed by improving services to their homes at 87%, improving management of markets at 86%. 50% of the respondents rated improving services to informal settlements as important. On the other hand, 35% of the respondents did not rate this objective at all. These ratings could be used to prioritise municipal management objectives in line with the expectations of the city residents.

4.5.1.2 Satisfaction with municipal engineering services

The respondents were requested to rate their level of satisfaction with a range of municipal engineering services (see Table 4-11). 75% of the respondents gave a score of satisfied and very satisfied with the provision of water supply. On the other hand, 67% of the respondents

were slightly satisfied or not satisfied with the provision of stormwater drainage; 64% slightly or not satisfied with street lighting and provision of access roads; and 57% slightly or not satisfied with provision of sanitation and public transport. The results of this exercise could be used as an indicator of potential areas that require improvement and as input to operational plans of the municipality.

Table 4-10: Rating of municipal objectives

Focus Areas	Importance of Focus Area					
	Very Important	Important	Slightly Important	Not Important	Not Sure	Not Stated
Improve security through law enforcement	58%	33%	4%	1%	1%	3%
Improve management of markets and shopping centres	40%	45%	11%	1%	2%	1%
Improve delivery of services to your home e.g. water supply, solid waste collection, drainage	69%	18%	8%	2%	3%	0%
Ensure proper management of KCC and NWSC with respect to proper staffing and good governance.	42%	39%	7%	4%	5%	3%
Improve social conditions with respect to street children and the homeless.	36%	35%	10%	9%	7%	3%
Improve public transport	29%	38%	22%	3%	2%	6%
Improve delivery of services (water supply, sanitation and solid waste collection) in informal settlements	38%	12%	11%	2%	3%	35%
Increase the number of open spaces such as parks	25%	23%	36%	9%	6%	1%

Table 4-11: Satisfaction with municipal engineering services

Description of Service	Level of Satisfaction with the Service					
	Very Satisfied	Satisfied	Slightly Satisfied	Not Satisfied	Not Sure	Not Stated
Provision of water supply	31%	44%	13%	8%	1%	3%
Provision of sanitation	7%	29%	30%	27%	4%	3%
Provision of public transport	4%	32%	35%	22%	2%	4%
Provision of access roads	6%	27%	38%	26%	1%	1%
Provision of storm water drainage	5%	20%	36%	31%	5%	3%
Provision of street lighting	11%	14%	27%	37%	5%	6%
Collection of solid waste	4%	9%	21%	36%	25%	5%

4.5.1.3 Prioritisation of water services

The respondents were requested to think about the financial constraints commonly faced by the city departments, and with that in mind, rate a list of focus areas that they believed the municipality should prioritise. In order to set the scene for the valuation of non-user benefits, the respondents were asked to prioritise from a list of water service levels that included services to their households and services to informal settlements (Table 4-12).

Reliability of water services was rated highest among the respondents, with 91% of respondents rating high and very high priority for reliability. Improving the response time to queries was rated high and very high by 84% of the respondents while protecting the environment was rated high by 81% of the respondents. In contrast the rating of municipal services resulted in the following: 70% of the respondents placed high priority on the provision of services to informal settlements and 74% on ensuring that the poor could afford the services offered. Provision of low quality water for non-potable use was given the lowest priority. As highlighted in the Table 4-12, concern for affordability among the poor and the provision of services to the poor ranked seventh and eighth out of the list of ten potential priority areas respectively. These findings suggest that the provision of services to the informal settlements will be prioritised lower than the services to the respondents' homes, and could potentially influence the outcome of willingness to pay for level of service upgrades in informal settlements if the respondents are not satisfied with services to their homes.

Table 4-12: Prioritisation of water services

Focus Area	Level of Priority					
	Very High	**High**	**Fair**	**Low**	**Not Sure**	**Not Stated**
Ensure 24 hour supply of water with no interruptions	59%	32%	5%	0%	1%	4%
Improve the response time to customer queries	58%	26%	9%	3%	2%	2%
Ensure adequate treatment of sewage to protect the environment	51%	30%	13%	3%	2%	1%
Improve the response time to fixing leaks	58%	19%	15%	4%	3%	1%
Ensure that the water quality is good enough to be drunk straight from the tap	53%	18%	9%	12%	5%	3%
The accuracy of the water bills	48%	18%	26%	7%	1%	0%
Provide advance warning in the event of service interruption	35%	31%	24%	5%	2%	3%
Ensure that the poor are provided with services at a price that they can afford	*45%*	*29%*	*11%*	*4%*	*0%*	*11%*
Provide informal settlements with water and sanitation facilities closer to dwellings	*43%*	*27%*	*16%*	*8%*	*3%*	*3%*
Increase the level of community participation	18%	40%	31%	7%	4%	0%
Provide water of lower quality for gardening and industrial purposes	16%	19%	20%	24%	18%	3%

4.5.2 The contingent valuation data

4.5.2.1 Preference for levels of service

The respondents were presented with a list of the obstacles faced by the city council, e.g. the high density of settlements which renders difficulty in installation of facilities; the temporary nature of housing which limits the technical options; low affordability levels; and the high cost of installation of services. The respondents were then requested to bear these obstacles in mind and choose their preferred level of service interventions. As illustrated in Figure 4-8, 44% of the respondents preferred to install communal taps, while 37% and 19% preferred yard taps and in-house taps respectively. With respect to sanitation, 37% of the respondents preferred to install VIP latrines, while 22% and 25% preferred in-house and yard toilets respectively. The elicitation of preference for water supply options was asked as a separate question to the preference for sanitation option. It was thus deemed appropriate to check for consistency in the respondents preferences. This was done by matching the technical compatibility of the choice outcomes for the sanitation options with the water options. The respondents' preferences were found to be fairly realistic: 19% of the respondents preferred an in-house water connection, which is fairly consistent with the 22% that preferred an in-house sanitation connection.

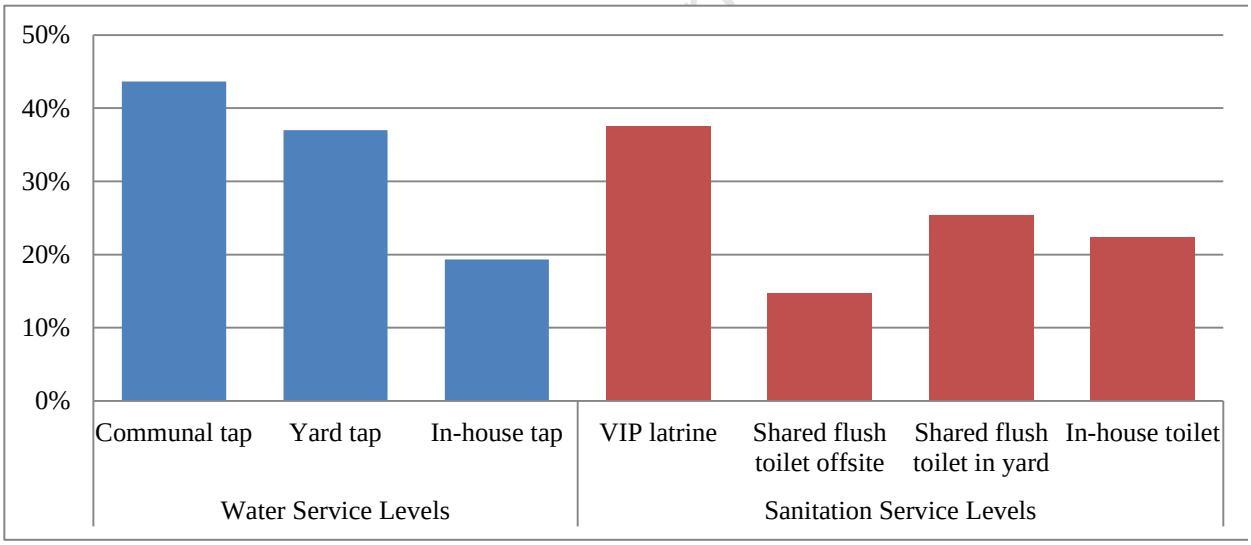

Figure 4-8: Preference for service levels (n=300)

4.5.2.2 Willingness to pay values

As shown in Figure 4-9, 50% of the respondents did not indicate an amount that they would be willing to pay for improvements in informal settlements. This could be interpreted as a protest vote (not willing to pay). This finding is comparable to the findings of the "free choice" model in which 45% of the respondents opted not to choose an improvement option.

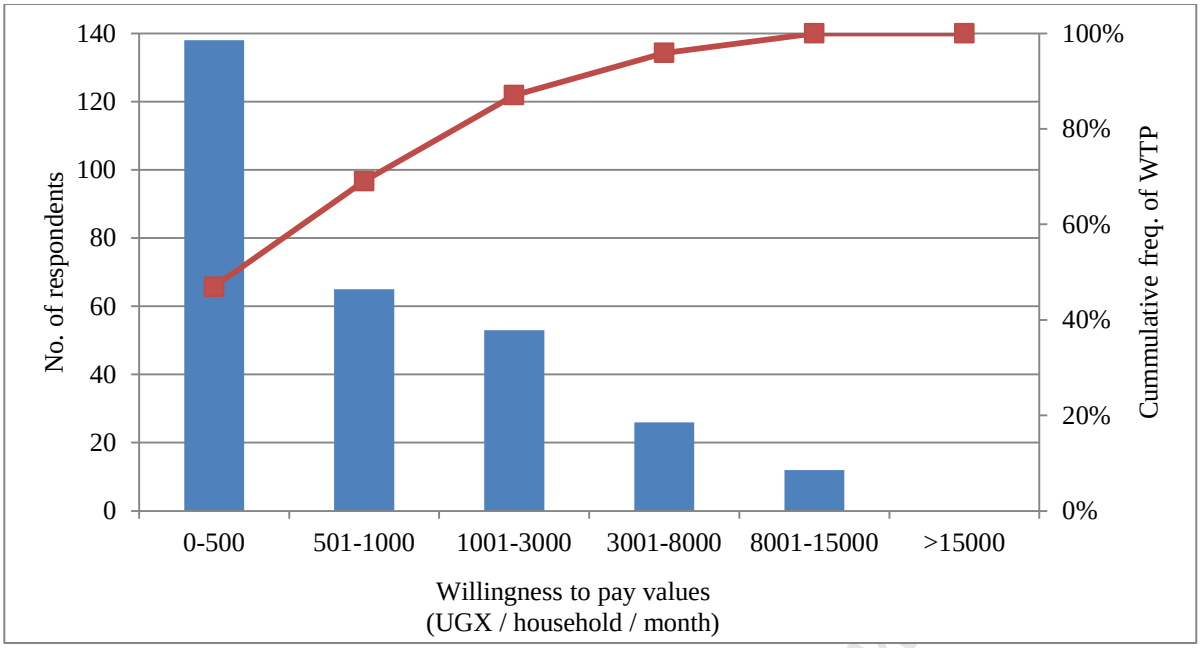

Figure 4-9: Maximum willingness to pay

The average willingness to pay is 1550 UGX per household per month. Of the willing respondents, 40% were willing to pay between 500 UGX and 3000 UGX per month. Among the 50% of respondents that stated a willingness to pay amount, the average amount they are willing to contribute was 2900 UGX per month, with a median value of 2000 UGX a month. The high percentage of respondents that did not state a willingness to pay amount could also have been as a result of respondent fatigue, having been presented with this section of the question after the choice experiment.

4.5.2.3 Preference for payment mechanism

There was a high protest vote against this question: 47% of the respondents did not state their preferred payment mechanism. This could be interpreted as being unwilling to pay, which is consistent with the 50% of respondents not indicating an amount in Section 4.5.2.2. As illustrated in Figure 4-10, the respondents that indicated a preferred payment vehicle, showed almost equal distribution in preference to collection through the water bill (17% of the respondents), government tax (19% of the respondents) and a dedicated fund (17% of the respondents). This order of preference is not consistent with the findings of the choice experiment which revealed a higher preference for payment via a dedicated fund.

4.5.2.4 Reasons for willingness to pay

This section of the questionnaire aimed to deconstruct the motives for willingness to pay. As illustrated in Figure 4-11, 55% of the respondents did not state any reasons for willingness

to pay, 24% of the respondents were willing to pay for altruistic reasons such as "wanting to help the poor", while 15% cited social reasons such as "good for development of the country". Environmental reasons scored low (cited by less than 5% of the respondents).

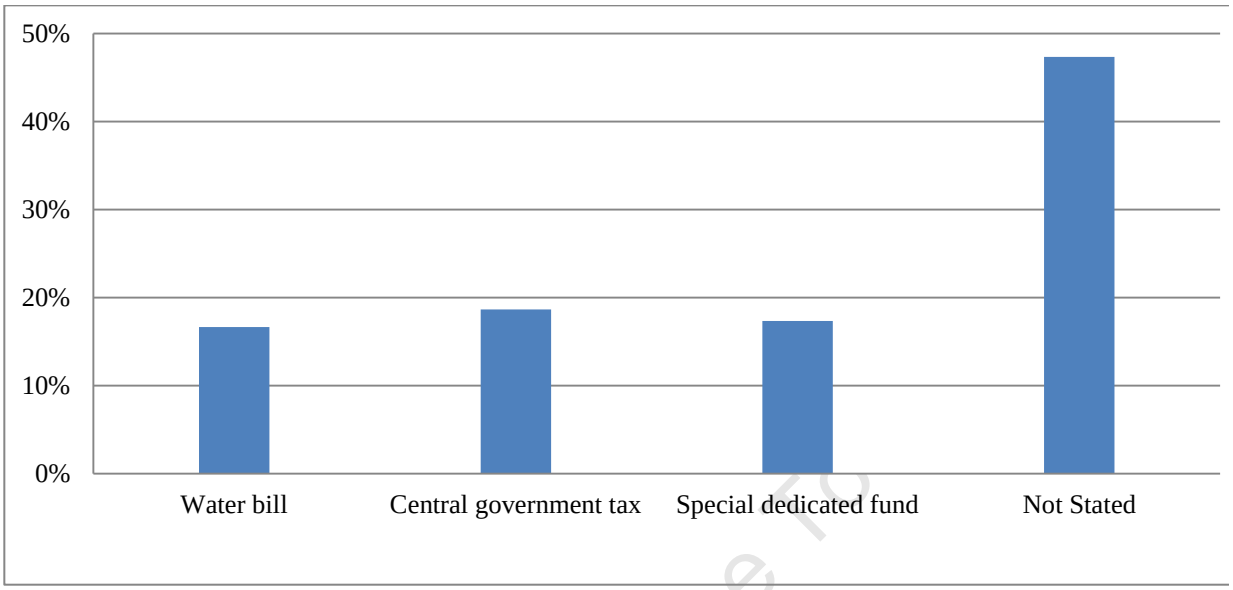

Figure 4-10: Preferred payment vehicle

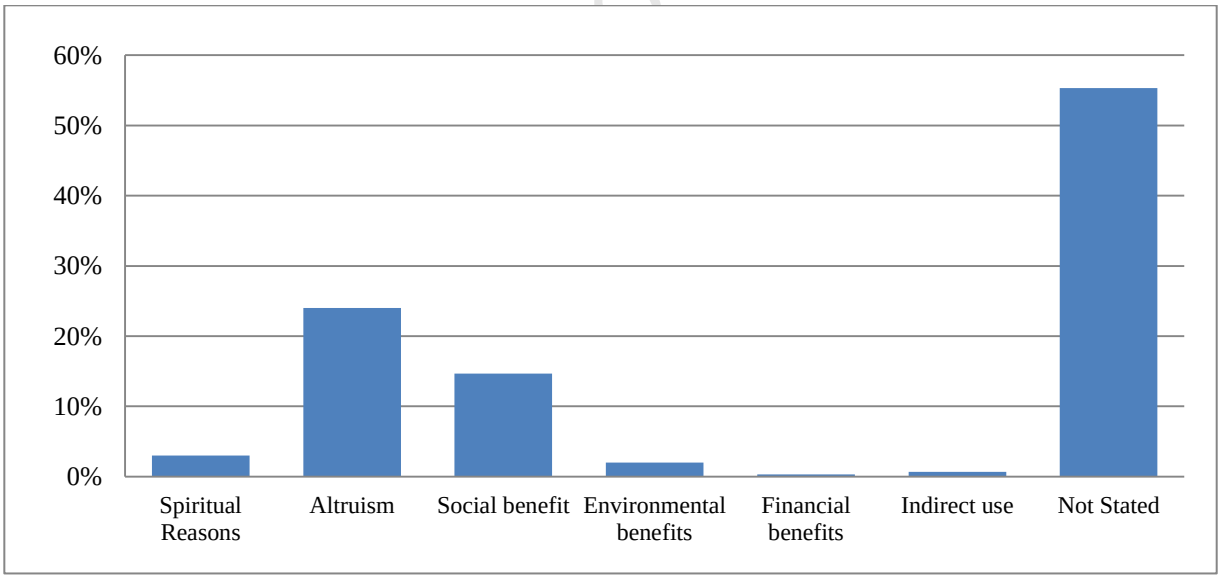

Figure 4-11: Motives for willingness to pay

In summary, the CV section of the questionnaire did not produce the expected results. *A priori* expectation was that highest preference would be given to the level of service that provides the highest level of comfort, i.e. the in-house facilities followed by the yard and shared facilities and lastly the communal facilities. Furthermore, when requested to state the amount that they

would be willing to pay towards improving levels of service, 50% of the respondents did not state any amount. CV studies have been found to produce different results from CE questionnaires, sometimes as a result of protest votes, i.e. indications of zero willingness to pay or due to respondent fatigue (the CV question was posed at the end of the questionnaire, after the respondents had answered the choice questions) (Merino-Castello, 2003; Stevens *et al*, 1999; Whittington, 1996).

4.5.3 The choice experiment

The choice experiment involved the presentation of eight randomly assigned choice sets to each respondent. Each of the choice sets involved a description of level of service costs and benefits and a request to choose which profile the respondent preferred as an intervention to improve services in informal settlements. The respondents were also presented with an option not to choose either of the two alternatives. An example of the question posed to the respondents is shown in Figure 4-12.

5 (a) The tables below describe costs and benefits associated with an improvement in the level of service to the poor.
Suppose you were required to choose an intervention to be implemented, which of the 2 sets would be your preferred choice? Please tick against your preferred option

Option 1		Option 2	
Level of Service	1 tap for every 200 people and communal VIP latrines	Level of Service	Yard Tap and flush toilet in the yard
The number of diarrhoeal infections per month	48 incidences for every 100 people	The number of diarrhoeal infections per month	18 incidences for every 100 people
The number of school days lost due to diarrhoea per month	3 days lost for every 100 children	The number of school days lost due to diarrhoea per month	1 day lost for every 100 children
The number of springs that do not comply with drinking water quality standards	10 springs out of 10	The number of springs that do not comply with drinking water quality standards	1 spring out of 10
The location of informal settlement to be improved	In another division of Kampala	The location of informal settlement to be improved	In another district in Uganda
The average amount of tax money spent by the government and by households on medical care for diarrhoea	3 000 UGX per household per month	The average amount of tax money spent by the government and by households on medical care for diarrhoea	600 UGX per household per month
Additional amount of money required from your household to install and maintain this level of service	2 000 UGX per month	Additional amount of money required from your household to install and maintain this level of service	8 000 UGX per month
The means through which your payment may be collected	Collected through central government taxes	The means through which your payment may be collected	As part of your water bill

2 11 Please tick Option 1 ☐ OR Option 2 ☐

5 (b) If you were given the opportunity not to choose either of the 2 options above, would you still choose your Preferred Option in (a) above?
YES ☐ NO ☐

Figure 4-12: Example of choice question

The experimental design was prepared as a labelled experiment with alternative specific constants, i.e. the respondents would be presented with the proposed level of service changes and requested to trade-off the attributes of each level of service. As such, there is no alternative-specific constant (β_{0i}) in the utility model. Unlabelled experiments have the

advantage of minimising perceptions that the respondents may have about an alternative, thus enhancing the requirement for independence of attributes, which is a key assumption of choice models (Hensher *et al.*, 2005). The estimated utility function is specified as shown below:

$$V_{i1} = \beta_{11i} * SAN_{i(COMMUNAL)} + \beta_{12i} * SAN_{i(SHARED)} + \beta_{13i} * SAN_{i(OWN)} \quad (4\text{-}1)$$
$$+ \beta_{2i} * DIR_i + \beta_{3i} * SDL_I + \beta_{4i} * POL_i + \beta_{5i} * COD_i + \beta_{6i} * COST_i$$
$$+ \beta_{71i} * PV_{i(BILL)} + \beta_{72i} * PV_{i(TAX)} + \beta_{73i} * PV_{i(FUND)}$$
$$+ \beta_{81i} * LOC_{i(NEIGHBOURHOOD)} + \beta_{82i} * LOC_i(_{DIVISION}) + \beta_{83i} * PV_{i(DISTRICT)}$$

where V_{i1} represents the utility, V that the Respondent 1 receives from alternative i from the choice set of j alternatives (and j=2), and β are the estimated coefficients: SAN represents communal, shared facilities, and yard facilities respectively; DIR represents the diarrhoeal incidence rate; SDL represents the school days lost; POL represents the number of polluted springs, COD represents the health agency cost; $PV_{(BILL)}$ represents payment through the water bill; $PV_{(TAX)}$ represents payment through government taxes; $PV_{(FUND\ )}$represents payment through a dedicated fund; $LOC_{(NEIGHBOURHOOD)}$ represents an informal settlement located near the respondent's neighbourhood; $LOC_{(DIVISION)}$ represents a location in another division in Kampala; and $LOC_{(DISTRICT)}$ represents a location in another district in Uganda. Table 4-13 shows the parameters estimated by the model and their expected sign.

Table 4-13: Estimated parameters and expected sign

Variable and notation used in model	Unit	Levels (Low or High value)	Expected Sign
Sanitation Level of Service (SAN)	1= sanitation service offered, 0 otherwise	VIP Latrine (LOS 1) Shared Flush toilet (LOS 2) Flush toilet in Yard (LOS 3)	+
Location of Informal Settlement to be improved (LOC)	1= location offered, 0 otherwise	Near respondent's neighbourhood In another division in Kampala In another district in Uganda	+
Means through which payment may be collected (PV)	1= payment option offered, 0 otherwise	Water bill Central government tax Dedicated fund	?
Number of diarrhoeal infections per month (DIR)	Continuous (No. / 100 people / month)	48 or 72 for LOS 1 24 or 36 for LOS 2 12 or 18 for LOS 3	-
Number of school days lost due to diarrhoea per month (SDL)	Continuous (No. / 100 children / month)	2 or 3 for LOS 1 1 or 2 for LOS 2 0 or 1 for LOS 3	-
Number of springs that do not comply with drinking water quality standards (POL)	Continuous (No. / 10)	6 or 10 for LOS 1 3 or 5 for LOS 2 0 or 1 for LOS 3	-
Average tax money spent by the government on medical care for diarrhoea (COD)	Continuous (UGX / household / month)	2000 or 3000 for LOS 1 800 or 1200 for LOS 2 400 or 600 for LOS 3	-
Additional amount of money required to provide this level of service (COST)	Continuous (UGX / household / month)	2000 or 3000 for LOS 1 4000 or 6000 for LOS 2 8000 or 12000 for LOS 3	-

4.5.3.1 The forced choice model

The data was analysed with a Multinomial Logit (MNL) model using the LIMDEP program. An exploration of the data revealed that there was correlation between the attributes representing the pollution level (POL) and school days lost (SDL) and cost. The variables consequently did not produce expected results and were excluded from the model. In order to limit the number of tests required, the experimental design only allowed for testing of main interactions, and as such, interactions between attributes could not be accommodated in the model. The low statistical significance of these attributes could also be attributed to the small changes in attribute levels, e.g. for each level of service, the changes in school days lost varied by one day, which could have been too small to be assimilated adequately and were thus not major contributors to the respondents' choice..

The model output is shown in Table 4-14. Model goodness-of-fit was tested using the log likelihood test and the rho-squared index. The log likelihood (LL) test gives the overall significance of the model. The test compares the model results with the results of the model fitted with explanatory variables equal to zero, i.e. no coefficients. The estimated model passes the overall significance test if the LL of the estimated model is an improvement on that of the base model (Hensher *et al.*, 2005). Estimated coefficients and the corresponding t-ratio tests are also shown in Table 4-14. Most of the variables exhibited the expected sign and magnitude. A negative sign indicates a reduction in utility while the converse is true for a positive sign.

The variables corresponding to sanitation level of service are highly significant, indicating that the level of service is an important factor in the respondent's choices. The negative sign on the coefficient for the VIP latrine and the shared flush toilet indicates a negative impact on utility while the positive sign of the coefficient for a flush toilet in the yard indicates a positive impact on utility. The coefficients can also be used to calculate respondents' willingness to pay for each attribute (the ratio of the coefficient of the attribute to the coefficient of cost), also shown in Table 4-14. When given the choice between yard and communal facilities, the respondents experience a part-worth disutility of 0.99 towards the communal facilities and the value of that part-worth disutility is 6220 UGX less than the value of their utility for yard facilities. Similarly, the respondents experience a part-worth disutility of 0.88 for shared facilities compared to yard facilities, and the value of that disutility is 5525 UGX less than the value of their utility for yard facilities. Putting it together, the respondents are willing to pay 11,745 UGX per month towards yard facilities; 6220 UGX per month towards shared facilities; and 5525 UGX per month towards communal facilities.

The coefficient corresponding to the diarrhoeal infection rate reflects the value that respondents attach to changes in the levels of diarrhoeal infection. As expected, there is decreasing utility as the diarrhoeal infection rate increases. That means that an increase in the diarrhoeal infection rate would reduce the probability that a respondent would select that level of service as an intervention option. 83% of the respondents highly favoured the level of service that would result in the lowest diarrhoeal infection rate. Furthermore, the probability of choosing a VIP latrine or a shared flush toilet did not change with changes in diarrhoeal

infection rate, indicating that respondents place high value and are more willing to choose a level of service that will result in the highest reduction in diarrhoeal infection. Respondents were willing to pay 104 UGX per month for a unit reduction in diarrhoeal infection (among 100 people per month). Based on the proposed change in diarrhoeal infection of 60 infections / 100 people for communal facilities and 20 infections / 100 people for shared and yard facilities, the respondent willingness to pay for the health benefits of level of service improvements is 6240 UGX per month towards communal facilities and 2080 UGX per month towards shared and yard facilities.

Table 4-14: Parameter estimates

Log Likelihood (Base)	-2636.67		
Log Likelihood (Model)	-1593.52		
Adjusted R-sq.	0.39		
	Coeff. (t-statistic)	**Willingness to Pay (UGX)**	**Willingness to Pay (2010 USD)**
VIP latrine	-0.99 (-2.42)	5525	3.3
Flush toilet shared between 7 households	-0.88 (-4.35)	6220	3.7
*Flush toilet located in the yard	1.86	11,745	7.0
*Informal settlement located near respondent's neighbourhood	0.39	2449	1.5
Informal settlement located in another division in Kampala	-0.23 (-3.41)	1008	0.6
Informal settlement located in another district in Uganda	-0.16 (-1.80)	1440	0.9
Pay through water utility company	-0.13 (-1.62)	1467	0.9
*Pay through central government tax	-0.23	847	0.5
Pay through specially dedicated fund	0.37 (5.23)	2314	1.4
Diarrhoeal infection rate (/ 100 people / month)	-0.02 (-4.08)	-104	-0.1
Cost of diarrhoea (UGX / household / month)	3.06E-04 (2.21)	2	0.0
Cost (UGX / household / month)	-1.58E-04 (-5.13)	-	

* Author's calculation

With respect to location, the respondents placed a higher value towards improving settlements nearest to their neighbourhoods. The negative sign of the coefficients indicates a reduction in the likelihood of choosing improvements in settlements farther from the respondents'

neighbourhoods. The lowest utility however, is not experienced for informal settlements located farthest from the respondents (in another district in Uganda) as would be expected. The willingness to pay for improvements in informal settlements near their neighbourhoods is 2449 UGX; informal settlements located in another division of Kampala is 1008 UGX; and informal settlements located in another district in Uganda is 1440 UGX. This could be attributed to the migration patterns experienced in the city. Many city migrants retain links to their home districts, which could explain the slightly higher utility for improvements in other districts (to where they may still have a connection) as compared to improvements in another division in Kampala (which is further from their neighbourhoods and to which they may not have any direct link).

The respondents' sensitivity to the mode of payment was also tested. The positive sign of the coefficient for dedicated fund indicates that the respondents would prefer to have their contribution collected into a special purpose vehicle rather than into the central government or instituting body's coffers. The negative sign of the coefficients for the water bill and the government tax indicate a disutility for both these payment means compared to the dedicated fund. The disutility associated with payments through the government tax system was valued at 1467 UGX while the disutility associated with payments through the utility company's billing system was valued at 847 UGX compared to the special fund. This means that the respondents are willing to pay 2314 UGX per month if the payment is made through a special fund; 1467 UGX per month if the payment is attached to their water bill; and 847 UGX per month if the payment goes through the central government tax system.

The coefficient corresponding to the cost of diarrhoea attempted to measure the trade-off between the level of service improvements and tax money spent on treatment of diarrhoea. Utility was thus expected to decrease as the tax money spent increased, i.e. the coefficient should bear a negative sign. Although this variable did not bear the expected sign, it was significant and was thus left in the model. Moreover, the magnitude of the coefficient was very small in comparison to the other estimated coefficients, and would constitute a very small proportion of the total utility.

The estimated model is as shown below:

$$\begin{aligned} V_{i1} = & -0.99 * SAN_{i(COMMUNAL)} - 0.88 * SAN_{i(SHARED)} + 1.86 * SAN_{i(OWN)} \\ & - 0.02 * DIR_l + 0.0003 * COD_i - 0.000158 * COST_i \\ & - 0.13 * PV_{i(BILL)} - 0.23 * PV_{i(TAX)} + 0.37 * PV_{i(FUND)} \\ & + 0.39 * LOC_{i(NEIGHBOURHOOD)} - 0.23 * LOC_{i(DIVISION)} - 0.16 * PV_{i(DISTRICT)} \end{aligned} \quad (4\text{-}2)$$

where V_{i1} represents the utility, V that the Respondent 1 receives from alternative i from the choice set of j alternatives (and j =2) and the attributes $SAN_{(COMMUNAL)}$ represents communal facilities, $SAN_{(SHARED)}$ represents shared facilities, and $SAN_{(OWN)}$ represents yard facilities; DIR represents the diarrhoeal incidence rate; COD represents the health agency cost of diarrhoeal treatment; $PV_{(BILL)}$ represents payment through the water bill; $PV_{(TAX)}$ represents

payment through the central government taxes; $PV_{(FUND)}$ represents payment through a dedicated fund; $LOC_{(NEIGHBOURHOOD)}$ represents an informal settlement located near the respondent's neighbourhood; $LOC_{(DIVISION)}$ represents an informal settlement located in another division in Kampala; and $LOC_{(DISTRICT)}$ represents an informal settlement located in another district in Uganda.

4.5.3.2 Influence of socio demographic characteristics

Socio demographic characteristics are a useful inclusion in models when designing solutions for specific groups of society or when the model aims at predicting impacts on demographic groups (Hensher *et al.*, 2005). In this case, it was deemed necessary to test what demographics would be more agreeable to a change in policy towards payment for services to others. The results could also be used as an indicator of the portion of the population that is most affected by poor services in informal settlements. The influence of the socio demographic characteristics of the respondents is shown in Table 4-15.

Table 4-15: Influence of socio demographic characteristics

	Coeff.(t-statistic)	Willingness to Pay(UGX)	Willingness to Pay (2010 USD)
Tertiary education	-0.19(-2.49)	-1203	-0.7
*Expenditure 100,000 - 340,000	0.07	468	0.3
Expenditure 340,000 - 850,000	-0.12(-1.65)	-738	-0.4
Expenditure above 850,000	0.04(0.29)	270	0.2

*Author's calculation

The respondents with higher (tertiary) levels of education showed a lower willingness to pay than those with lower (certificate) levels of education. Willingness to pay is also seen to decrease with increasing monthly expenditure. This could also be attributed to a lower perception of benefits among the more educated and among the higher income respondents, partly due to a dissociation with the lower income sections of society or due to lower perception of risk of the dangers associated with poor services in informal settlements, e.g. although the previous cholera outbreaks have originated in informal settlements, the outbreaks have always been contained and not spread to the other parts of the city. It could also be that the higher income respondents, being in a higher tax bracket, feel less duty bound and are less willing to increase their household expenditure on societal objectives for which the government should be responsible (through tax already paid). Gender and age were not significant in explaining the choice of intervention and were thus excluded from the model.

Putting it all together, the respondents' willingness to pay was highest when the informal settlement was located near the respondent's neighbourhood and when the payment mode was through a special dedicated fund. As shown in Table 4-16, the total willingness to pay estimate was 16,228 UGX per household per month; 13,063 UGX per household per month; and 18,588 UGX per household per month respectively. The willingness to pay an additional 1671 UGX per month can be determined among the respondents with certificate level education and from the lower middle income respondents.

Table 4-16: Willingness to pay estimates

Attribute	Willingness to Pay (UGX / month)		
	Communal facilities	**Shared facilities**	**Yard facilities**
Informal settlement located near the respondent's neighbourhood	2449	2449	2449
Payment through a special dedicated fund	2314	2314	2314
Health benefits	6240	2080	2080
Level of service	5225	6220	11,745
Total willingness to pay (UGX / household / month)	**16,228**	**13,063**	**18,588**
Total willingness to pay (2010 USD / household / month)	9.68	7.79	11.09

4.5.3.3 Model effects

Based on the model output, the communal facilities were chosen 29% of the time; the shared facilities 45% of the time and the yard facilities 26% of the time (Table 4-17). Elasticity calculations were carried out to measure the percentage change in the probability of choosing the alternative in response to changes in price. Table 4-17 shows the elasticity values and the changes in choice probabilities when the price is varied. The results show the elasticity effect to be -0.33 and -0.70 for the VIP and shared toilet alternatives respectively. This implies that a 1% increase in price will reduce the probability of selecting the communal alternative by 0.33% and of selecting the shared toilet alternative by 0.70%. Based on Table 2-9 in Chapter 2, it can be said that the price of installing the two alternatives is relatively inelastic, i.e. preference for the alternatives is not responsive to price changes.

On the other hand, the elasticity value of -1.36 towards installation of yard facilities indicates that a 1% increase in the price of installation will result in a 1.36% decrease in the probability of choosing the alternative (i.e. is relatively elastic). This means that the preference for the yard facilities is sensitive to price changes; a reduction in price will likely result in an increase in the preference for the yard alternative, and vice versa.

Table 4-17: Elasticity of price for the forced choice model

	Forced Choice Model		
	Probability	**Elasticity**	**Interpretation**
Communal facilities	29%	-0.33	Relatively inelastic
Shared facilities	45%	-0.70	Relatively inelastic
Yard facilities	26%	-1.36	Relatively elastic

A simulation exercise was carried out to test the impact that changes in installation prices would have on the choice probabilities. Using the estimated model, scenarios involving a 50% decrease in cost and a 20%, 50% and 100% increase in the installation cost of the level of service were tested.

The simulations for the preference for communal facilities showed that increasing the cost of installation did not adversely change the probability of choosing communal facilities. As shown in Figure 4-13, the change in choice probability for the communal facilities ranged between a 3% increase for a 20% increase in cost and a 13% increase in probability with a 100% increase in installation cost.

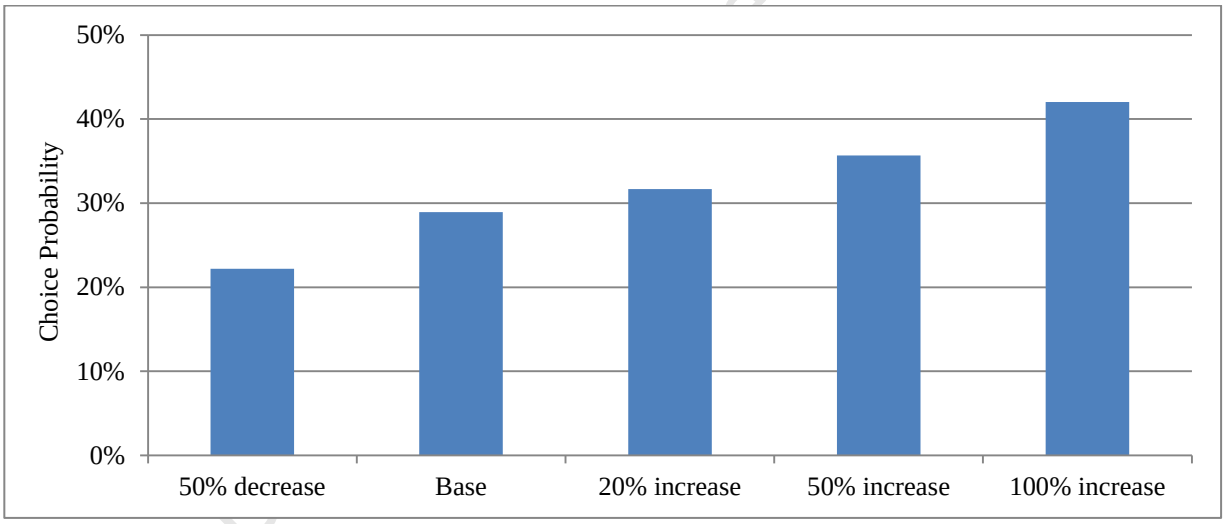

Figure 4-13: Choice probabilities for changes in costs for communal facilities

Similarly, the simulations for the preference for shared facilities showed that increasing the cost of installation does not adversely change the probability of choosing shared facilities. As shown in Figure 4-14, the choice probabilities for the shared alternative increased when the cost of installing shared facilities increased. The increase in probabilities ranged between 0.5% to 3% for a 20% to a 100% increase in installation cost.

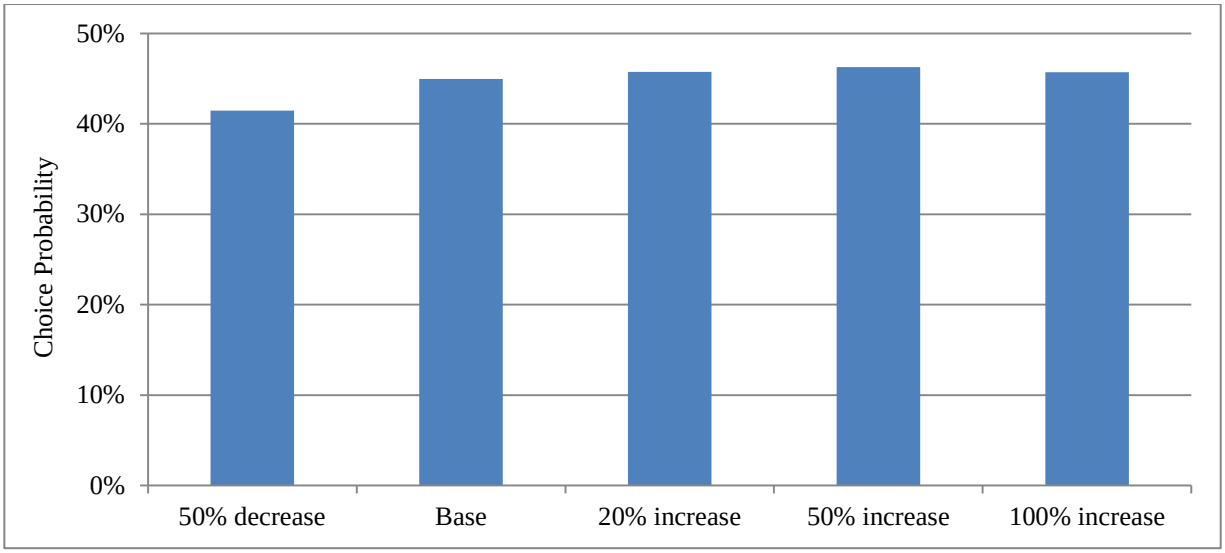

Figure 4-14: Choice probabilities for changes in costs for shared facilities

The simulation exercise for the yard alternative revealed that the preference for the yard facilities was sensitive to changes in cost. As shown in Figure 4-15, increasing the cost of installing yard facilities by 20%, 50% and 100% would result in a 3%, 8% and 14% reduction in choice probability. Conversely, a 50% reduction in installation cost increased the choice probability for yard facilities by 10%.

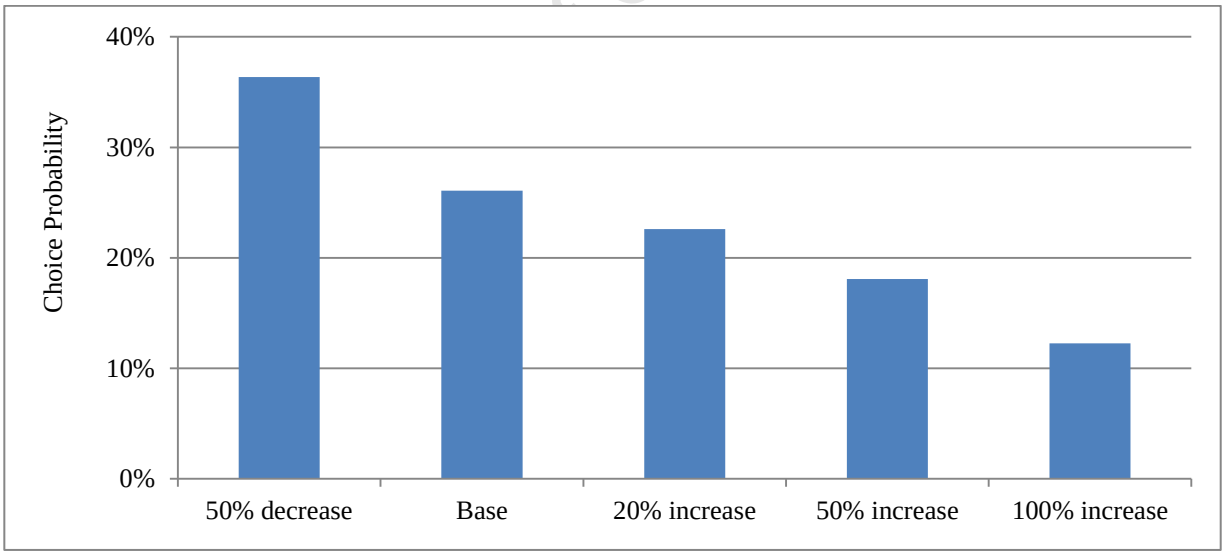

Figure 4-15: Choice probabilities for changes in costs for yard facilities

4.5.3.4 Impact of the "free choice" option

The results discussed in the preceding sections are based on a "forced choice", in which the respondents were given two improvement options to choose from and no opportunity to opt out of making a choice. It has been argued that inclusion of an option to opt out of making a choice

provides a more realistic decision-making environment since people are rarely "forced" to make choices (Dhar & Simonson, 2003). The respondents were thus presented with a second part of the choice question, in which they were given the opportunity not to choose any of the two improvement options. The "free choice" option was included in the MNL model as an extra alternative, with the cost variable set to zero. As shown in Table 4-18, when given the opportunity, 52% of the respondents opted out of choosing an improvement. The communal facilities were chosen in 14% of the cases; the shared facilities were chosen in 20% of the cases and the yard facilities were chosen in 14% of the cases.

Table 4-18: Choice probabilities for the "Free Choice" model

Level of Service	Choice probability
Communal facilities	14%
Shared facilities	20%
Yard facilities	14%
Free Choice	52%

A basic assumption of MNL models is that the ratio of the choice probabilities of the alternatives is independent of the presence or absence of other alternatives, i.e. the independence of irrelevant alternatives (IIA). There are concerns that the inclusion of the "free choice" alternative may result in systematic favouring of the alternative to opt-out, especially when faced with higher price alternatives, thus violating the IIA assumption and potentially biasing the parameter estimates and choice proportions (Brazell *et al.*, 2006; Dhar & Simonson, 2003). When given the opportunity, the alternative to opt out of making a choice was preferred 52% of the time. This finding is similar to Dhar & Simonson (2003), who tested the format of posing "free choice" questions, and found that the choice proportion for the "free choice" alternative was likely to be higher when the "free choice" option followed a forced choice. They attribute this to a possible lack of commitment to the previous forced choice.

Brazell *et al.* (2006) and Humphreys (2003) used a simulated dataset to test for differences in choice proportions and in parameter estimates between a dual response experiment (presentation of a forced choice followed by a "free choice"), and a single step "free choice" experiment. They found that where the "free choice" option is chosen frequently, parameter estimates are likely to be influenced by average weights. They applied a scaling factor to account for the variance, and thus produce more realistic estimates. Kontoleon & Yabe (2003) also found differences in parameter estimates resulting from different "free choice" formats; with a larger effect on the estimates corresponding to attributes that are more important to consumers. On the contrary, Rolfe & Bennet (2009) attribute the differences in their parameter estimates to structural issues related to the design and implementation of the survey instrument and not to any underlying behavioural pattern. A comparison of the parameter estimates resulting from the two elicitation formats are shown in Table 4-19.

Table 4-19: Impact of "free choice" option on parameter estimates

	Coeff. (Forced Choice)	Coeff. (Free Choice Model)
No. of Observations	2400	2400
Log likelihood – base model	-2636.67	-3327.11
Log likelihood – estimated model	-1593.52	-2467.63
Rho-squared	0.39	0.26
Free Choice		-1.56
VIP Latrine	-0.99	-1.18
Shared Flush Toilet	-0.88	-1.19
Own Toilet in Yard	1.86	2.38
Near Neighbourhood	0.39	0.52
In Another Division in Kampala	-0.23	-0.24
In Another District in Uganda	-0.16	-0.27
Water Bill	-0.13	-0.49
Central Government Tax	-0.23	-0.51
Dedicated Fund	0.37	1.00
Diarrhoeal Infection Rate	-0.02	-0.02
Increase in Pollution Levels	-	0.13
Cost of Diarrhoea	3.06×10^{-4}	-
Cost	-1.58×10^{-4}	-1.22×10^{-4}

Table 4-20 shows the proportion of choice shares under the forced and free choice conditions. Under forced choice conditions, communal facilities were chosen 26% of the 1200 times that the option was presented to the respondents. When the free choice option was presented, the share proportion dropped to 14%. Similarly, the shared facilities were chosen 49% of the 2400 times that they were presented, and dropped to 20% under free choice conditions. The shift from yard facilities to the opt-out alternative was similar to the communal facilities, dropping from 25% of 1200 times to a choice probability of 14%.

Table 4-20: Choice shares across level of service options

	Forced Choice	Free Choice
Communal Facilities (n=1200)	26%	14%
Shared Facilities (n=2400)	49%	20%
Yard Facilities (n=1200)	25%	14%
Free Choice (prefer to opt out) (n=2400)		52%

The proportions when the option not to pay was included indicate that the preferences were disproportionately drawn among the alternatives; the preference for shared facilities reduced by 29% while the preference for the communal and yard facilities reduced by 12% and 11%

respectively. Furthermore, the ranking of preference also changed, with highest preference remaining towards shared facilities, but followed by yard and communal facilities respectively.

4.6 The value of non-user benefits in Kampala

The results of the "forced choice" model were analysed further to assess the potential impact of the willingness to pay estimates on planning level of service improvements. As explained in Section 4.5.3.3, when the respondents in Kampala were asked to pay towards improving levels of service in informal settlements, the model showed that 26% of the population chose to pay towards installing communal VIP latrines; 49% chose to pay towards shared flush toilets; and 25% chose to pay towards yard toilets. When the informal settlement is located near the respondent's household and when the payment mode is a dedicated fund, the respondents were willing to pay 16,228 UGX per household per month; 13,063 UGX per household per month; and 18,588 UGX per household per month for communal, shared and yard facilities respectively (Table 4-21).

Table 4-21: Willingness to pay estimates for Kampala

Level of Service	WTP Estimate (UGX/ household / month)	WTP (2010 USD/household / month)
Communal Facilities	16,228	9.68
Shared Facilities	13,063	7.79
Yard Facilities	18,588	11.09

1 USD = 1676 UGX (BoU, 2010)

4.6.1 Application of value estimates in investment decisions

The primary objective of this thesis was to investigate the potential of non-user value in increasing the resource pool for financing of improvements in levels of services in informal settlements. In order to illustrate the potential impact of non-user value on municipal revenue generation, the findings of the study were tested against the investment requirements of the city. The overall significance of non-user value on investment appraisals were also tested as described below.

4.6.1.1 Comparison of investment costs and potential revenue

The strategy of the utility company is to provide communal standpipes (i.e. one tap for every 200 people) as the minimum service level in informal settlements (PEM Consult & SEREFACO, 2008). A beneficiary population of 104,000 households (the unserved population) was adopted as the baseline. An additional population of 10,000 households, representing the current households that are serviced by communal standpipes was included with the beneficiary

households for shared and yard facilities (NWSC, 2008). The provision of sanitation in the city is institutionally fragmented with sewered sanitation being the responsibility of the utility company while on-site sanitation is the responsibility of the city council. The minimum level of service is communal ventilated pit latrines. However due to high densities, the latrines require frequent emptying, which poses a financial challenge to the communities. Furthermore, the informal settlements are commonly located in areas with a high water table, which makes latrines an environmental risk. As shown in Table 4-22, three levels of service options were investigated. The costs estimates were based on NWSC (2007) and are attached in Appendix D.

- Communal water taps and elevated ventilated pit latrines to the 104,000 households that are currently below the minimum level of service. An estimated 1.21 billion UGX per month is required to provide this level of service.
- Tap and flush toilet, shared between 7 households, to be provided to the 104,000 households that are currently unserved and the 10,000 households that are using communal taps and simple pit latrines. An estimated 1.97 billion UGX per month is required to provide this level of service.
- Tap and flush toilet in the yards of the 104,000 households that are currently unserved and the 10,000 households that are using communal taps and simple pit latrines. An estimated 3.5 billion UGX per month is required to provide this level of service.

Table 4-22: Investment requirements for Kampala City

	Communal Facilities	Shared Facilities	Yard Facilities
Benefiting population (No. of households)	104,000	114,064	114,064
Annualised Cost per facility (UGX / household / year)	139,557	207,742	368,041
Total Capital and O&M Costs (UGX / year)	14,513,928,000	23,695,883,488	41,980,236,731
Total Capital and O&M Costs (UGX / month)	1,209,494,000	1,974,656,957	3,498,353,061
Total Capital and O&M Costs (2010 USD / month)	721,655	1,178,196	2,087,323

The paying population was taken as 213,000 households, i.e. the number of households who do not live in informal settlements and whose income is above the average household income of UGX 100,000 per month (UNHS, 2006). The aggregated willingness to pay values result in potential revenue of 3.52 billion UGX per month towards the installation of communal facilities; 2.78 billion UGX per month towards the installation of shared facilities; and 3.96 billion UGX per month towards installation of yard facilities (Table 4-23).

Table 4-23: Potential revenue from non-user value in Kampala

Level of Service	Willingness to pay (UGX / household / month)	Total willingness to pay (UGX / month)	Total willingness to pay (2010 USD / month)
Communal facilities	16,528	3,520,464,000	2,100,516
Shared facilities	13,063	2,782,419,000	1,660,155
Yard facilities	18,588	3,959,244,000	2,362,317

Table 4-24 shows the comparison between the investment requirements (Table 4-22) with the potential revenue from non-user benefits (Table 4-23). As shown in the Table 4-24, for the three level of service options, the potential revenue from the non-user benefits exceeds the cost of installing the three water and sanitation facilities. The non-user value results in potential revenue that exceeds the capital and operational cost of communal facilities by 2.91; shared facilities by 1.41; and yard facilities by 1.13. This means that the municipality could potentially finance the required level of service improvements by harnessing the non-user value from the residents of the city that do not live in informal settlements.

Table 4-24: Comparison of costs and potential revenue from non-user benefits

Level of Service	Investment cost (UGX / month)	Total willingness to pay (UGX / month)	Benefit-Cost ratio
Communal Facilities	1,209,494,000	3,520,464,000	2.91
Shared Facilities	1,974,656,957	2,782,419,000	1.41
Yard Facilities	3,498,353,061	3,959,244,000	1.13

4.6.1.2 Non-user value as a component of total economic value

One of the secondary objectives of this study was to identify the components of non-user value that could make a significant contribution to the total economic value of urban water services. According to NWSC (2009), the average household water bill in Kampala is 14,000 UGX per month, implying that the value of the non-user benefits of the communal, shared and yard facilities represent about 54%, 48% and 57% of TEV respectively (Table 4-25). The ratio of use to non-use value was found to be 0.86; 1.07; and 0.75 for communal; shared; and yard facilities respectively. These findings are comparable with the findings in Loomis (1987) where the non-user value was found to be 52% of the TEV of improving water quality; in Bristow *et al* (1991) where non-user value was found to range between 39% to 50% of the TEV of public transportation; and in Brown (1993) where the ratio of use to non-use value was found to range between 0.11 to 10.47.

Table 4-25: Non-user value as a component of total economic value

Level of Service	Willingness to pay (UGX / month)	Proportion of total economic value	Use : non-use ratio
Communal Facilities	16,228	54%	0.86
Shared Facilities	13,063	48%	1.07
Yard Facilities	18,588	57%	0.75

In order to assess the potential impact of inclusion of non-user benefits in valuation studies, a benefit cost analysis was carried out. Due to difficulties in determining the monetary value of environmental benefits such as changes in pollution, and socio-economic benefits such as gains in school attendance, this study only included the economic benefits described below:

i. Direct economic benefits of avoiding diarrhoeal disease, i.e. financial savings from reduced treatment of diarrhoeal illness.

ii. Indirect economic benefits related to health improvements, i.e. health agency savings on diarrhoeal treatment.

iii. Non-health benefits related to water and sanitation improvements, i.e. the productive days gained by reduced illness or time taken away from work to take care of a minor.

The inputs and assumptions made are shown in Table 4-26.

Table 4-26: Inputs to calculation of economic benefits

	Value	Reference
Diarrhoeal incidences (% of households)	60%	UBOS (2007)
Average diarrhoeal cases	2.1	Schnabel (2009)
% of incidences that seek treatment	63%	Schnabel (2009)
% caregivers that accompany minors to treatment	88%	Schnabel (2009)
Average cost of self-medication (patient costs at a pharmacy) (UGX per case)	11,000	Schnabel (2009)
Average wage rate among the low income population (UGX per month)	124,000	Schnabel (2009)

As shown in Table 4-24, the benefit cost ratios, based on the savings in health centre and patient costs, the value of time savings, and the value of non-user benefits were 22.07 for the communal facilities; 2.84 for shared facilities and 1.94 for the yard facilities. This means that at a societal level, there are net positive benefits from installing communal, shared and yard facilities. Furthermore, the non-user benefits were found to constitute a significant portion of the total societal benefits, estimated at 13%, 50% and 58% of the total benefits of providing communal, shared and yard facilities respectively. Hutton *et al.* (2006) found that the benefits

from time savings provide the largest proportion of the total benefits of improving levels of service (ranging between 63% for water and 89.7% for sanitation service). The findings of this study were consistent with their findings, i.e. the proportion of benefits from time savings is approximately 87% when the non-user benefits were not included. When the option was to provide the lowest level of service (communal facilities), the benefits derived from time saving still constituted the largest portion of societal benefits (i.e. 86% of total benefits). However, Table 4-27 when the option is to install shared and communal facilities, the non-user benefits provided the highest contribution to the total societal benefits of improving levels of service.

Table 4-27: Comparison of costs and benefits of level of service interventions

	Communal Facilities	Shared Facilities	Yard Facilities
Number of beneficiaries	104,000	114,064	114,064
Annual installation costs per facility (UGX / year)	139,557	207,742	368,041
Total annual installation costs	**14,513,928,000**	**23,695,883,488**	**41,980,236,731**
Total diarrhoeal cases (No. / year)	131,040	143,721	143,721
Health system costs saved (UGX / year)	6,854,570,270	3,175,200,000	3,175,200,000
Patient costs saved (UGX / year)	908,107,200	995,984,035	995,984,035
Value of time saved from reduced illnesses (UGX / year)	270,252,702,720	29,640,484,888	29,640,484,888
Value of non-user benefits (UGX/non-poor household / month)	16,528	13,063	18,588
Total value of non-user benefits (non-poor households=213000) (UGX / year)	42,245,568,000	33,389,028,000	47,510,928,000
Total annual benefits (UGX / year)	**320,260,948,190**	**67,200,696,923**	**81,322,596,923**
Benefit cost ratio	22.07	2.84	1.94
Annual cost per non-poor beneficiary (UGX/year)	68,141	111,248	197,090

These findings suggest that the value of non-user benefits has the potential to improve the outcome of investment appraisals. The benefit cost ratios for the three level of service options indicate that there is a net positive societal benefit from improving levels of service. The inclusion of non-user value contributes to the positive outcome of this analysis. For all three improvement options, the total revenue from the non-user value exceeds the cost of installing the facilities, suggesting that the municipality could potentially finance its upgrade programmes by harnessing the non-user value among the non-poor members of the society.

4.7 Summary of findings

The study found that the maximum willingness to pay was 16,528 UGX (2010 USD, 9.86) per household per month; 13,063 UGX (2010 USD, 7.79) per household per month; and 18,588 UGX (2010 USD, 11.09) per household per month for communal, shared and yard

facilities respectively. The willingness to pay was highest when the informal settlement was located near the respondent's household and when the payment mode was a dedicated fund.

The study also found that the non-poor respondents in Kampala were sensitive to health benefits and were willing to pay 6240 UGX (2010 USD, 3.72) per month for the reduction in diarrhoeal incidences associated with communal facilities and 2080 UGX (2010 USD, 1.24) per month for the reduction in diarrhoeal incidences associated with shared and yard facilities. An additional 1671 UGX per month could potentially be paid by respondents with certificate level education and by lower middle income respondents.

This study did not measure the respondents' willingness to pay for water and sanitation to their own homes, and thus inferred user value from the average household water bill, which amounts to UGX 14,000 (2010 USD, 8.35) per month. Based on the value typology described in Chapter 2, and on the assumption of an average water bill of UGX 14,000 (used as proxy for user value), the non-user value represents 54%, 48% and 57% of the total economic value of the communal, shared and yard options respectively. It should however be noted that the household water bill is a lower bound on the gross willingness to pay.

The study found that the potential revenue from the non-user benefits exceeded the cost of installing the three water and sanitation facilities by 2.91 for communal facilities; by 1.41 for shared facilities; and by 1.13 for yard facilities. This means that the municipality could potentially finance level of service improvements from harnessing the non-user value from the non-poor residents of the city. When the societal benefits (including savings in health center and patient costs and the value of time savings) were incorporated, the benefit cost ratios were 22.07 for the communal facilities; 2.84 for shared facilities and 1.94 for the yard facilities. This means that at a societal level, there are net positive benefits from installing communal, shared and yard facilities.The study also found that the non-user benefits constituted a significant portion of the total societal benefits, estimated at 13%, 50% and 58% of the total benefits of providing communal, shared and yard facilities respectively.

Elasticity calculations indicated that the preference for communal and shared facilities was not very sensitive to price changes. The option to install yard facilities was however sensitive to price changes and it is likely that the preference for yard facilities will decrease if prices were increased. A simulation exercise in which costs were varied between -50% and 100% also revealed that increasing the cost of the yard alternative reduced the probability of its selection as a preferred alternative.

The study also found that when asked to prioritise municipal services, concern for affordability among the poor and provision of services to the poor ranked seventh and eighth out of the list of ten potential priority areas respectively. These findings suggest that the provision of services to informal settlements will be prioritised lower than services to respondents' homes, and could potentially influence the outcome of willingness to pay for level of service upgrades in informal settlements if the respondents are not satisfied with services to their own homes.

The primary objective of this research was to investigate the potential of non-user value in increasing the resource pool for financing of water services. The findings of this study suggest that there is a willingness among the non-poor members of Kampala city, to pay for improving the levels of water and sanitation services in informal settlements. The willingness to pay is influenced by the location of the informal settlement to be upgraded, the mode of payment and the expected health benefits from improving the water and sanitation services. Three level of service improvement options were tested: the option to install communal facilities; shared facilities; and yard facilities. In all three cases, the potential revenue from the non-user value was higher than the capital and operational cost of the facilities. This implies that municipalities could harness these benefits for the purpose of financing level of service upgrades in informal settlements.

5. The case of Cape Town

This chapter discusses some of the challenges faced in service delivery to informal settlements in South Africa. The method developed in Chapter 3 has been applied to quantify the value of non-user benefits of improving levels of service in informal settlements in the City of Cape Town in South Africa. Cape Town, the second largest city of South Africa, has an estimated population of three and a half million and a population growth rate of 1.61% (CoCT, 2008a). Approximately 20% of households in Cape Town live in informal settlements, characterised by inadequate housing, poor municipal infrastructure and high levels of poverty and illiteracy (CoCT, 2008c). Despite the city's annual GDP growth of 4.4% there are concerns that increasing levels of poverty, disease and unemployment (attributed to high numbers of people with low-skills), may retard efforts to reduce the levels of social inequality that the city is striving to achieve (Nleya, 2008; CoCT, 2008b; IDP, 2005). Figure 5-1 illustrates the spatial variations in income levels in the city.

5.1 Water services in Cape Town

5.1.1 Policy framework

The Constitution of South Africa (1996) through the Bill of Basic Human Rights guarantees all citizens the right to an environment that is not detrimental to their health and wellbeing. The provision of safe water and adequate sanitation are linked to the enhancement of health, dignity and gender rights and thus play an important role in the constitutional mandate. The National Water Act (1998) specifies that the Government through the Department of Water and Environment Affairs (DWAE) act as custodian of the country's water resources and should ensure the provision of water supply for basic human needs and for environmental use. The implementation framework through which the government realises its development objectives is contained in the Reconstruction and Development Program (ANC, 1994). Through the Reconstruction and Development Program (RDP), the government aims to promote social and economic development by way of the provision of basic municipal services to all (ANC, 1994). With respect to water services, basic services are defined as a water supply of adequate quality and quantity between 20 and 30 litres per capita per day at a maximum distance of 200 m from the household, and improved sanitation on site (ANC, 1994). The provision of free basic services is intended to ensure that all households, including poor households can access the basic level of municipal services required to maintain a healthy and dignified life. The levels of service definitions adopted in many South African cities follow the water and sanitation ladder as adopted from UNICEF & WHO (2012) (see Table 5-1).

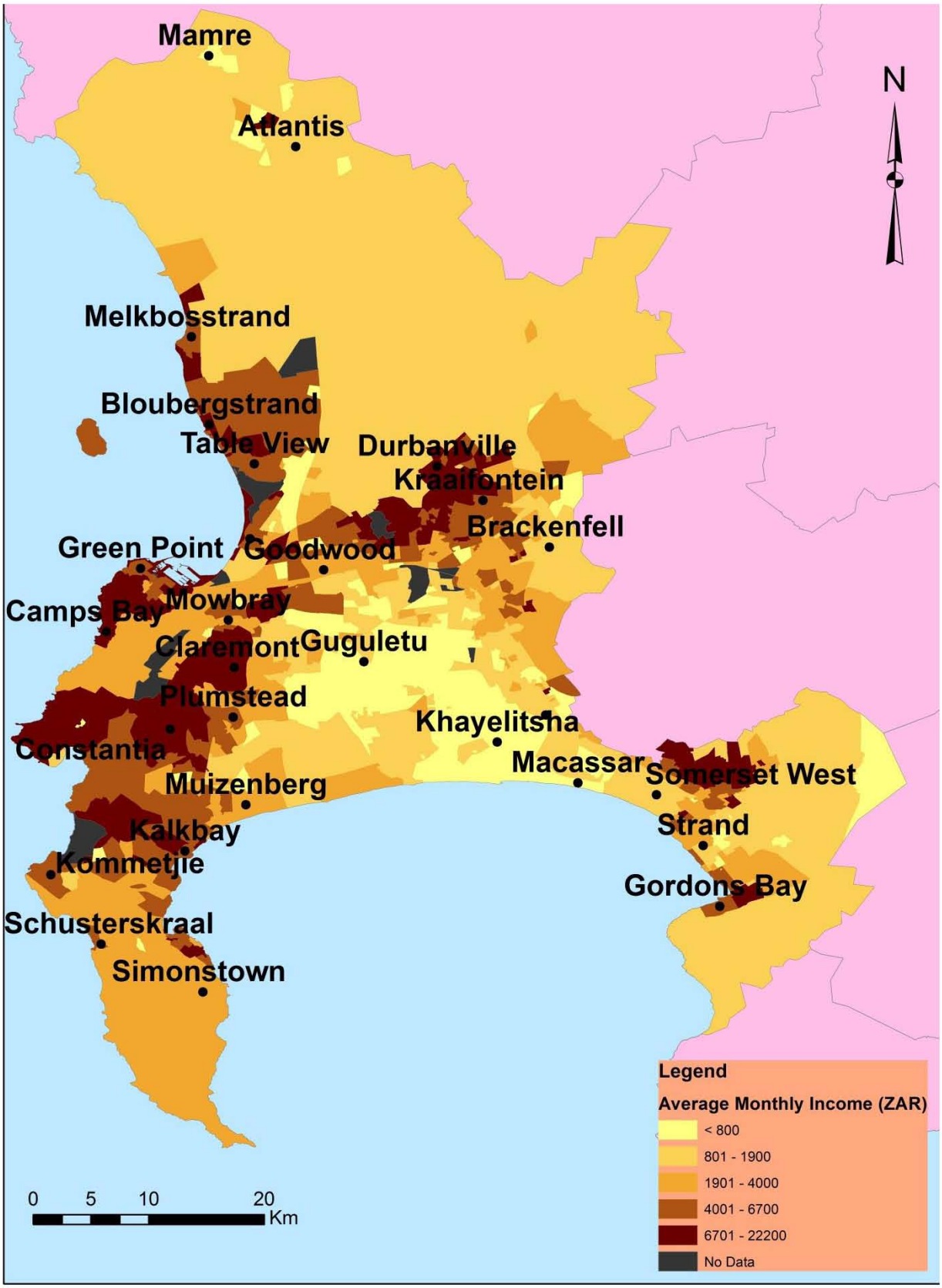

Figure 5-1: Spatial distribution of income levels in Cape Town(2001 Census data)
(CoCT, 2006)

Table 5-1: Water and sanitation ladder

LOS Category	WATER
Inadequate	No access to basic water supply
Emergency	Partial access to basic water supply, as dictated by site-specific constraints (e.g. high dwelling densities)
Basic	The provision of potable water (usually through communal taps): within 200 metres of a household; at a ratio of not more than 25 households per tap
Full	House connection
LOS Category	**SANITATION**
Inadequate	No access to sanitation
Emergency	Partial access to sanitation (more than 5 households per toilet), as dictated by site-specific constraints (e.g. high dwelling densities)
Basic	A shared toilet (not more than 5 families per toilet) which is safe, environmentally sound, easy to keep clean, provides privacy
Full	On-site waterborne or septic tank

(CoCT, 2009)

The White Paper on Water and Sanitation of 1994 aims to address urban water issues by setting up institutional structures, clarifying service delivery mandates, and setting strategic guidelines with respect to service levels and payment mechanisms. Under this institutional framework, the National Government is the custodian of the water resource and, through the Department of Water Affairs, manages the allocation and protection of water resources and ensures the provision of adequate water and sanitation for all (DWAF, 1994). Local government is responsible for the supply of water to customers to meet the standards set by the National Government while the provision of bulk water supply is carried out through Water Boards (DWAF, 1994).

Free basic services are financed by the National Government through the Municipal Infrastructure Investment Framework. The grant also includes operation, maintenance and capacity building costs as support to local government (Mjoli *et al.*, 2009). However, recurring service level improvement costs are to be met from the municipality's own revenue (Mjoli *et al.*, 2009). The White paper on Water and Sanitation of 1994 encourages cost recovery as a sustainable mechanism for financing urban water services (DWAF, 1994). The mechanism of implementation of any cost recovery principles is however a key determinant in the success of any financing policy. In the City of Cape Town, attempts to implement a debt management policy among low income communities in 2000 resulted in the disconnection of 71% of the 7327 new connections made that year (Smith & Hanson, 2003). A national survey conducted in 2001 by the South Africa Human Science Research Council found that low-income households were paying about 25% of their household income for essential services, and could not afford any further payments toward debt recovery (McDonald, 2002). It is thus imperative that

appropriate financing strategies are set up that promote sustainable municipal service delivery while still meeting the government concerns for equity.

5.1.2 Service delivery challenges in South Africa

Since 1994, the Government of South Africa has implemented various policies aiming to bridge the service and income inequality gaps through *inter alia*, provision of basic water, sanitation and electricity services, and improvement of education among low income communities. Studies show that although these polices have realised tremendous improvements in the lives of many households, there are some municipalities that lack the financial and institutional capacity to administer the projects to provide the basic services, and require either additional financing or institutional support (e.g. with respect to project administration and infrastructure management) to meet their investment activities (Muller, 2008; Tissington *et al.,* 2008).

5.1.2.1 Institutional challenges

According to the White paper on Water and Sanitation of 1994, urban authorities are required to not only provide a free basic level of service, but also to increase the level of service once basic needs have been met (DWAF, 1994). Studies show that the poorer municipalities, especially those with relatively large numbers of low income population are not able to sufficiently cross-subsidise the free basic services (Muller, 2008; PDG, 2001). Several other institutional challenges pertaining to the provision of services to the poor have been identified, including: low levels of stakeholder participation in decision making which has frequently resulted in civil contestation (e.g. see Western Cape High Court (2010) case in which civil protests broke out against "open" toilet superstructures provided by the City of Cape Town in Makhaza settlement); and low human resource capacity to administer infrastructure projects and thereafter manage the infrastructure (Muller, 2008).

There are also challenges associated with choice of technology to be installed in informal settlements.Figure 5-2shows the sanitation options available in informal settlements in Cape Town. Container and bucket latrines are emergency sanitation options, intended for interim use prior to an upgrade to a basic level of service (Mels *et al.,* 2008). The "basic" level of sanitation (see Table 5-1) provided by the city is either a container toilet or a flush toilet shared between five households, and a communal standpipe at a maximum distance of 200 m from each dwelling (CoCT, 2009). However experience shows that container toilets are expensive to maintain (Tissington *et al.,* 2008). Poor usage and practice have resulted in the container toilets being a hygiene and health hazard (Tissington *et al.,* 2008). Inadequate management practices particularly with respect to emptying and maintenance have also resulted in low operational life of the toilets. Efforts to upgrade sanitation services in informal settlements are hampered by the high and increasing density of households and by limitations in the capacity of the current low-cost technologies to serve the high densities that are experienced in these informal settlements

(CoCT, 2009). With respect to water supply, the "basic" level of service in Cape Town is a tap shared between 25 households (CoCT, 2009). In spite of the city's efforts to provide a higher level of service (i.e. by June 2009, the level of access was 11 households per tap), communal taps are often subject to vandalism and are proving to be expensive to maintain (CoCT, 2009).

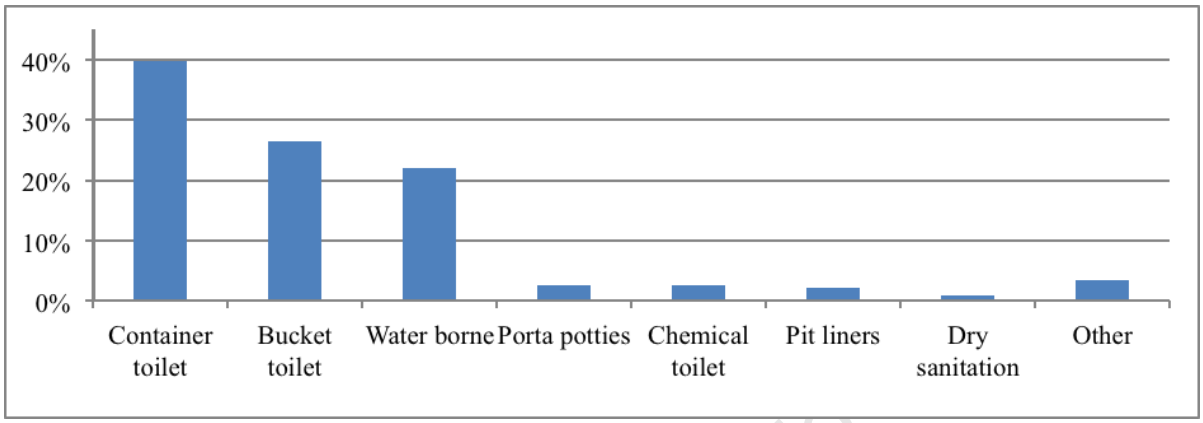

Figure 5-2: Sanitation options in informal settlements in Cape Town
(Mels *et al.*, 2008)

It is reported that some municipalities lack the administrative and technical capacity to manage existing services, and are overwhelmed with the additional task of overseeing level of service upgrades and service expansion programs (Muller, 2008). Given the capacity challenges in some municipalities, and in the face of conflicting demands for time and resources, the provision of free basic services has been known to be de-prioritised (Muller, 2008; Tissington *et al.*, 2008). This is also compounded by the fact that the cost of increased service coverage is not matched by an increase in ability of the consumer to pay, which impacts the quality of service provided by the municipalities (Tissington *et al.*, 2008). Furthermore, the provision of basic services to people that cannot afford to maintain or upgrade the infrastructure has created a situation where a large proportion of the population has the lowest LOS with little hope of climbing up the LOS ladder, other than through slum upgrade and/or housing programs (Smith & Hanson, 2003).

5.1.2.2 Financial challenges

In South Africa, the delivery of water and sanitation services to the poor is the responsibility of the local government. The costs for these services are met through a combination of sources:

- The Municipal Infrastructure Grant (MIG), which is a consolidated conditional grant to municipalities, aimed at meeting the capital cost of infrastructure development with respect to the free basic service policy. The MIG is however a temporary financing channel, only

intended to run until 2013 or until municipalities are able to meet their own capital costs with internally generated funds (Tissington *et al.*, 2008).

- The Local Government Equitable Share (ES) is a grant from central government to local government, which is aimed at subsidizing operation and maintenance (O&M) costs.
- User charges, structured through increasing block tariffs in which the first block of consumption is free and the subsequent consumption blocks are charged higher tariffs to cross-subsidise the cost of free water provision.

Studies have found that the allocations from the MIG and ES are insufficient to meet expansion and improvement plans (Muller, 2008: Tissington *et al.*, 2008). National government has steadily reduced support to municipalities, which has placed tremendous stress on the municipalities' capacity to provide quality services while ensuring that backlogs in expansion are met. Although the ES is intended to finance operations and maintenance activities, it is an unconditional grant, and municipalities that are resource constrained often divert the ES allocation to other priority areas, which exposes the infrastructure to deterioration and results in poor quality of services (Muller, 2008).

Cost recovery is crucial for continued expansion and improvement of services. In principle, improving levels of service improves cost recovery owing to the fact that private connections are expected to have a higher contribution to cost recovery because they are metered and the customers are identified through a billing system (Alence, 2002). Studies however show that although cost recovery principles are effective as a revenue generation strategy among the non-poor, they are not successful when extended to the poor. Firstly, poor families who default and are disconnected cannot afford the reconnection fees (Anti-Privatisation Forum, 2008; McDonald, 2002; Alence, 2002). Secondly, there is the argument that there are situations where more than one family is served by one meter and hence the free water allowance and the block water rates based on one meter per household is not appropriate (Mosdell, 2006; McDonald, 2002; Alence, 2002; Walker *et al.*, 2000; Mycoo, 1996).

The Water and Sanitation policy of 1994 emphasises a demand-driven approach to service provision and recommends the recognition of the economic value of water (DWAF, 1994). Moss *et al.* (2003) recommend that the price of water services reflects not only the cost of provision but also incorporates concerns for equity and economic and environmental sustainability.

5.2 Survey method

The study included a combination of survey methods: informal interviews (used to identify the potential sources of non-user value); and face-to-face interviews (used to apply the questionnaires during the main survey). This section discusses the application of the method

and the rationale of the choices made with respect to the elicitation method, interview format and sampling frame.

The calculations are based on a beneficiary population of 267,000 households, representing the estimated 117,000 households living in informal settlements and 150,000 households living in backyard shacks (CoCT, 2008) and the target population of 469,000 households, representing the number of households that earn above R3000 a month (STASA, 2008). The structure of the questionnaire is also discussed in detail.

5.2.1 Level of service options

The choice of improvement options was based on the service delivery plans of the City of Cape Town (CoCT, 2009). Three improvement options were presented to the respondents:

i. One tap for every 20 households and a container toilet shared between five households. For the rest of this chapter, this level of service shall be referred to as communal facilities.

ii. One tap per household and a flush toilet shared between five households. For the rest of this chapter, this level of service shall be referred to as shared facilities.

iii. One tap and a flush toilet in the household yard. For the rest of this chapter, this level of service shall be referred to as yard facilities.

5.2.2 Identification of value attributes

The attributes were identified based on *a priori* judgement and a review of various studies. In order to ensure that all possible value attributes were explored, a list of benefits was compiled and validated by asking 50 respondents (sampled using the snowballing technique) to rank the benefits they felt were most important to them. An example of the questionnaire is attached in Appendix A. This process was useful in narrowing down the list of possible variables and ensuring that relevant variables were applied to the survey. The units of measurement were also determined and refined during this process. The rationale of assigning the units of measurement was based on units used in previous valuation studies (Okun, 1998; Esrey *et al.*, 1990) and refined based on the ease of cognition by the respondents.

5.2.2.1 Health benefits

A list of potential health benefits was presented to the respondents. The benefits included a reduction in levels of mortality due to diarrhoeal disease among children under five years; a reduction in infection by diarrhoeal disease among children; and a reduction in the number of infections of water borne diseases such as diarrhoea.

The benefit that the respondents preferred was a reduction in the number of infections from diarrhoeal and intestinal diseases; ranked most preferred by 48% of the respondents. The

second most preferred benefit was a reduction in child mortality due to diarrhoea, chosen by 41% of the respondents (see Figure 5-3). The rankings for preference for reduction in diarrhoeal infection among children were significantly lower at 7%, probably resulting from possible similarity with the benefit measuring the reduction in child mortality due to diarrhoea. When the scores for the most preferred and second most preferred benefits were added, the reduction in child mortality due to diarrhoeal disease scored highest (a total of 81% compared to 70% total for the diarrhoeal infection rate). Because the socio-economic indicator that was scored the highest was the number of school days lost due to diarrhoea (see Table 5-3**)**, it was decided to avoid the potential correlation between variables as a result of similarity in the target beneficiary, i.e. benefits to children. The benefit relating to child mortality was therefore dropped as a health benefit in order to retain the benefit of reduced school absenteeism as a socio-economic benefit. The health benefit adopted for this study was thus the reduction in infections due to water-borne diseases such as diarrhoea.

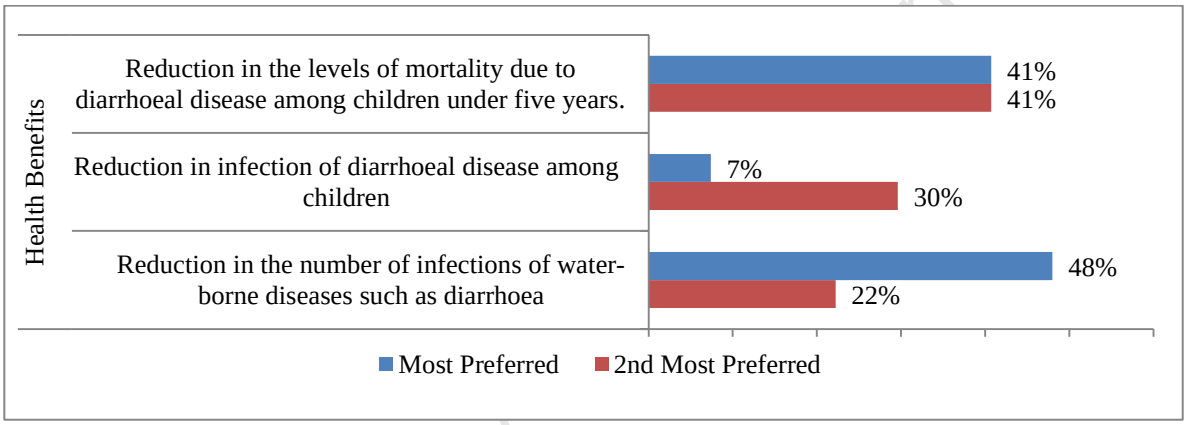

Figure 5-3: Cognition of potential health benefits

The diarrhoeal incidence rates applied in this study were adapted from a study that was carried out by DWAF (2001) in Stellenbosch, a town near the City of Cape Town. DWAF (2001) investigated the diarrhoeal infection rates associated with three levels of service: communal taps and chemical toilets; yard facilities; and in-house facilities. In the determination of diarrhoeal infection rates, this study made two assumptions: (i) similar public health and socio-demographic conditions in Stellenbosch and in Cape Town, thus enabling adoption of the findings of the Stellenbosch study; and (ii) the diarrhoeal infection rate for shared facilities to be the average of the yard and communal incidence rates. The unit of measurement adopted for the survey is the diarrhoeal incidence per 1000 people per month. Table predicts that out of 1000 people using communal water and chemical toilets, 364 people will experience an incidence of diarrhoea every year. Similarly, out of 1000 people using yard facilities and shared facilities, 284 people and 324 people will experience diarrhoeal infection every year respectively.

Table 5-2: Diarrhoeal incidence

Level of Service	Incidence / 1000 people / year	Incidence / 1000 people /month
*Communal Facilities	364	30.3
Shared Facilities	324	27
*Yard facilities	284	23.7

* Source: DWAF (2001)

5.2.2.2 Economic benefits

Two potential economic benefits were tested: the potential time savings and the financial savings. The time savings tested were: a reduction in absenteeism from school resulting from diarrhoeal illness; a reduction in absenteeism from work among adults taking care of sick children; and a reduction in absenteeism from work among sick adults. As illustrated in Figure 5-4, the reduction in the number of days that sick children are absent from school was the most recognised benefit, being chosen by 65% of the respondents as the most preferred benefit and by 30% of the respondents as the second most preferred benefit that they would like to see. The indicator for time saving benefits adopted for the study was thus measured through the savings in school days that would otherwise be lost due to diarrhoeal illness.

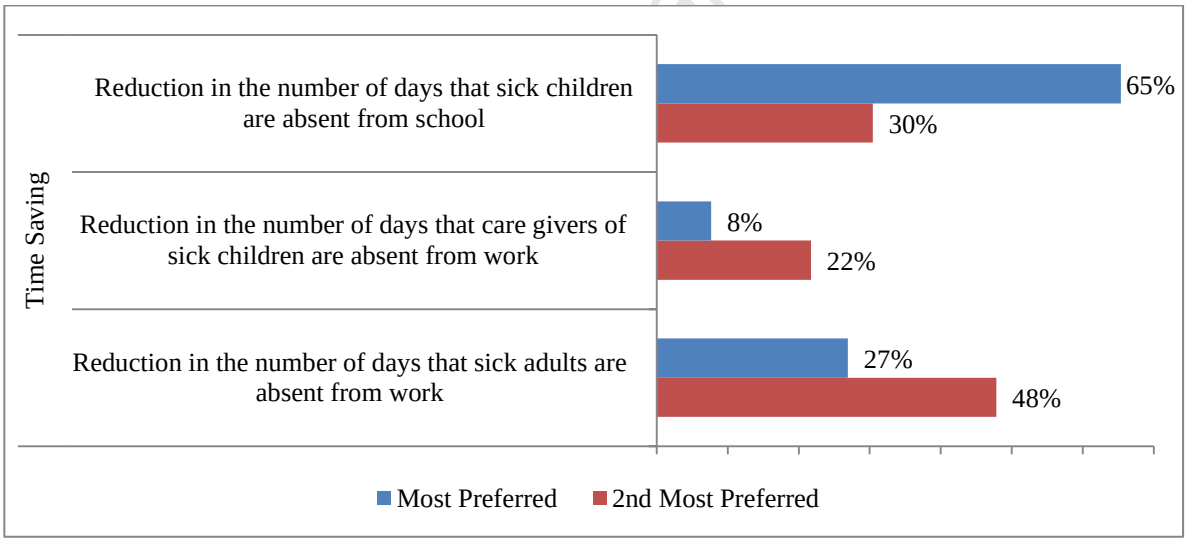

Figure 5-4: Preference for time saving benefits

The number of school days lost due to diarrhoea was determined based on health centre records on severity and duration of illness for the school-going age group (i.e. patients below 16 years of age) from each level of service. The findings of DWAF (2001) were applied to determine the values applied to this study. As shown in Table 5-3, there are an estimated 11 school days lost to 1000 children younger than 16 years that are using communal facilities, and 8 school days lost to 1000 children younger than 16 years that are using yard facilities per month. The school

days lost per month for the intermediate level (shared facilities) was taken as the average of that of the communal facilities (status quo) and the yard facilities (see Table 5-3).

Table 5-3: School days lost due to diarrhoea

Level of Service	School days lost / 1000 children / month
*Communal Facilities	11
Shared Facilities	10
*Yard facilities	8

* Source: DWAF (2001)

The financial savings tested were: a reduction in production costs to businesses, reduction in labour costs due to reduced absenteeism from work, reduction in health insurance costs for employees and a reduction in tax money spent on the treatment of diarrhoea in health centres. As illustrated inFigure 5-5, the benefit that the respondents most preferred was the reduction in tax money spent on the treatment of diarrhoea in health centres, chosen by 63% of the respondents. The second most preferred benefit was the reduction in absenteeism from work, chosen by 50% of the respondents. The indicator for financial savings adopted for the study was measured by the potential savings in tax money that would otherwise be spent on treatment of diarrhoeal disease.

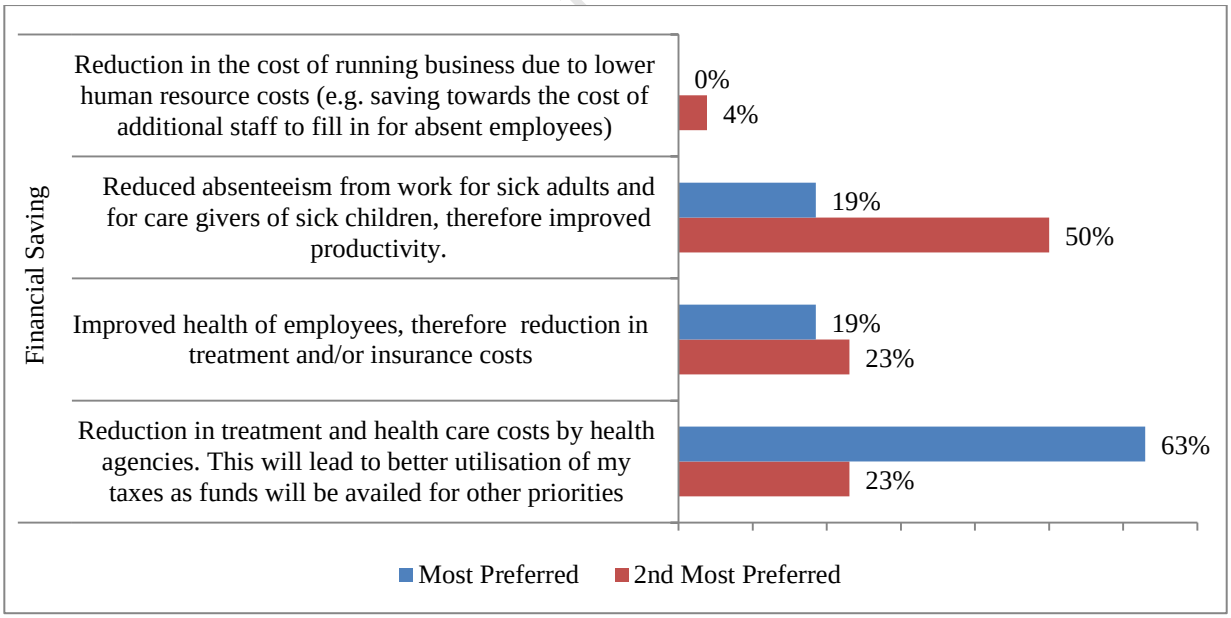

Figure 5-5: Ranking of financial benefits

According to DWAF (2001), the percentage of diarrhoeal cases treated at clinics is 14% and at hospitals is 1%. The average length of admission to a hospital was taken as three days at an

average treatment cost of R875 per day. The average treatment cost at a clinic was taken as R32.10. The costs were distributed among the target population to determine the cost of diarrhoea to each tax-paying household, and adjusted to 2009 costs using the PPI index (STATSA, 2009), as detailed in Appendix E and summarised in Table 5-4.

Table 5-4: The cost of diarrhoea to the target population

Level of Service	Health Facility	Total costs (2001 Rand) A	Cost to Target Household (2001 R) A / 469000	Cost to Household (2009 R / month)	Total Cost / Household (2009 R / month)
Communal Facilities (167000 beneficiary households)	Clinic	1,775,700	3.79	6	R13
	Hosp.	1,880,832	4.01	7	
Shared Facilities (Beneficiary households = 266883)	Clinic	998,022	2.13	4	R8
	Hosp.	1,057,110	2.25	4	
Yard Facilities (Beneficiary households = 266883)	Clinic	778,676	1.66	3	R6
	Hosp.	824,778	1.76	3	

5.2.2.3 Environmental benefit

The list of potential environmental benefits included improvement in the aesthetic quality of informal settlements; reduction of pollution thus preservation of water resources for future generations; and reduction in tax money spent on environmental clean-ups. 64% of the respondents stated that they most preferred a reduction in pollution of water courses for use by future generations. CoCT (2005) reports that most of Cape Town's rivers are unsafe for recreational use and further cites pollution from informal settlements as the major non-point source of surface water pollution in the city. The indicator of environmental benefit adopted for the study was a reduction in pollution of rivers and streams. Since no literature could be found on the effect of different levels of service on pollution in rivers in Cape Town, it was assumed that providing a yard tap and shared flush toilets would reduce the percentage of polluted rivers and streams from 30% to 10% and to 20% respectively.

5.2.2.4 Social benefits

Similar to the case of Kampala, the respondents were presented with the following potential social benefits: gender-related concerns with respect to reducing the burden of fetching water by women and children; concern for social equity; concern for living conditions of friends, family and vulnerable members of society that live in informal settlements. As illustrated in Figure 5-7, the respondents were most concerned with social equity and wanted to see the conditions in informal settlements improved.

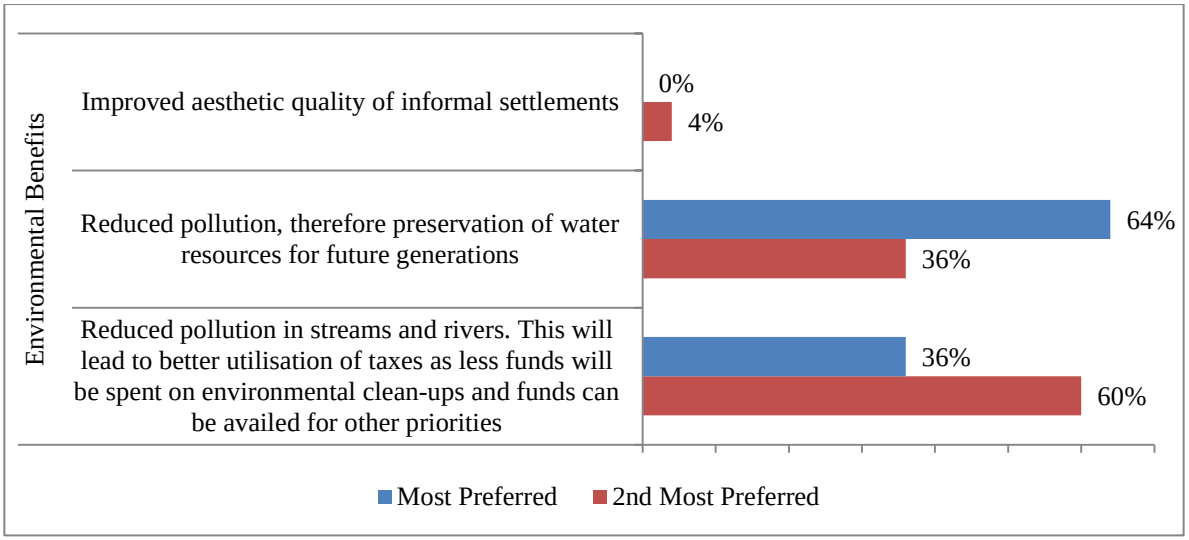

Figure 5-6: Preference for environmental benefits

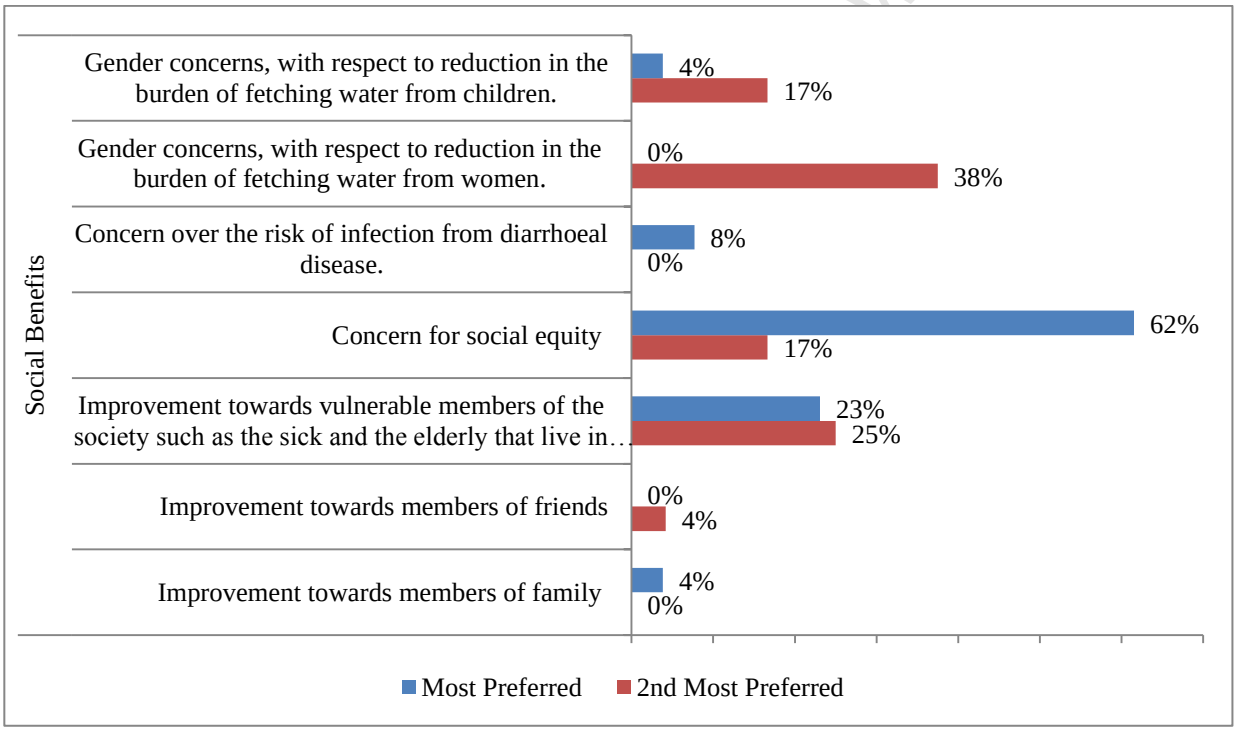

Figure 5-7: Preference for social benefits

5.2.2.5 Cost of providing each level of service

The annualised capital and maintenance cost of providing each level of service was calculated as shown in Table 5-5. The unit costs were adopted from CSIR (2000), annualised over the 20 year design life of the intervention at a discount rate of 8% and adjusted to 2009 costs using a PPI index (STATSA, 2009). Details of the inputs to the table are shown in the Appendix E.

Table 5-5: Calculation of annualised costs (2009 Rand)

Description of costs (unit of measurement)	Communal Facilities	Shared Facilities	Yard Facilities
Unit capital cost per facility (Rand)	846	5315	9116
Annualised capital costs (Rand / year)	86	541	928
Annual O&M (Rand / year)	65	559	1108
Total annual costs per facility (Rand / year)	151	1100	2036

1 USD = 7.9 ZAR (Standard Bank, 2011)

In order to determine the price per paying household, the study made the assumption that the total contribution of the paying households would be in proportion to the city's revenue from water and sanitation services provided to the residences. The total residential water demand is 67% of the total water demand of the city (CoCT, 2009). All other water uses were categorised into non-residential water use (institutional, government and business). The billable residential water demand, as reported in CoCT (2009) was adjusted to account for free basic water (6 kilolitres per household per month) and indigent free basic water (10.5 kilolitres per household per month). Average tariffs were then used to calculate the revenue. The calculated revenue from residential water accounts for 70% of the total revenue from water and sanitation. This was found to be comparable to the revenue posted in the Water Services Development Plan of 2010 (CoCT, 2009). The city's revenue from other sources (property rates, licences and permits, interest earned on investment, etc.) account for approximately 36% of the city's revenue (CoCT, 2010). It was therefore assumed that the non-poor residential water users would contribute 64% of the investment budget for improving levels of service, and the city would meet the remaining 36% from their other revenue sources. Further calculations can be found in Table 5-6.

$$P_{PH} = C_F * \frac{266883}{469000} * 70\% * 64\% \quad (5\text{-}1)$$

where P_{PH} is the annual price per paying household; C_F is the total annual cost (per facility) of providing the service; 70% represents the contribution to the total cost by residential customers; 64% represents the contribution by water and sanitation services; 266,883 is the number of beneficiary households; and 469,000 is the number of paying households.

Table 5-6: Monthly costs per paying household

Description of costs(unit of measurement)	Communal Facilities	Shared Facilities	Yard Facilities
Total annual costs per facility (Rand)	151	1100	2036
Total annual costs (Rand) Beneficiary population = 266883	28,222,000	293,700,000	543,612,000
Annual cost per paying population (Rand) No. of paying households =469000	60	438	811
Monthly cost per paying household (Rand)	3.2	23.4	41.4

5.2.2.6 The effect of distance

Similar to the study in Kampala, the study tested the influence of the location of the informal settlement on the respondents' preferences. Three locations were presented to the respondents:

i. The informal settlement is located near the respondents' neighbourhood.
ii. The informal settlement is located in another suburb of Cape Town.
iii. The informal settlement is located in another province of South Africa.

5.2.2.7 The payment mechanism

Similar to the study in Kampala, the study tested the influence of the payment mechanism on respondents' preferences. Three payment options were presented to the respondents:

i. Payment through local property tax.
ii. Payment through the household utility bills.
iii. A special fund could be created with the aim of separating the revenue generated from other revenue collected by the instituting agency.

5.2.2.8 Summary of attributes

The attributes used in the survey are summarised in Table 5-7. Each attribute was described as a benefit to be realised when the level of service is improved from the status quo i.e. communal facilities. In order to ensure equity, the cost per paying household was varied in proportion to the socio-economic level of the household. It was assumed that the higher income households would pay on average 80% more than the middle income households.

Table 5-7: Values for the attributes used in the study

Attribute	Description of benefit (unit of measurement)	Shared Facilities	Yard Facilities
Health benefit	Reduction in the number of diarrhoeal infections (No. / 1000 people / month)	3.3	6.7
Social / economic benefit	Savings in school days (No. / 1000 children / month)	1.1	2.2
Environmental benefit	Reduction in number of polluted rivers and streams (No. / 100)	10%	20%
Economic benefit	Savings in tax money spent by hospitals and clinics on treatment of diarrhoea (Rand / paying household / month)	5.7	7.4
Cost of Intervention	Cost to middle income households (Rand / paying household / month)	14.8	26.2
	Cost to high income households (Rand / paying household / month)	23.4	41.4

5.2.3 Experimental design

The attribute levels are used to represent changes in quality of the attribute under valuation. The attributes measuring the distance effect and the influence of the payment mechanism were tested at three levels as shown in Table 5-8.

Table 5-8: Three-level attributes used in the survey

Attribute and Description	Level 1	Level 2	Level 3
Distance Effect Location of Informal Settlement to be improved	Near respondents' neighbourhood	In another suburb of Cape Town	In another province of South Africa
Payment Mechanism The means through which payment may be collected	As part of the municipal bill	As part of local property taxes	Through a dedicated fund

Due to resource constraints, this study chose to limit the size of the survey and used two levels for five of the attributes, with a higher level set to +20% of the average value, and a lower limit set to - 20% of the average value, as illustrated in Table 5-9.

A total of two attributes at three levels and five attributes at two levels were identified for the main survey. This implies that a total of 288 (2^5 x 3^2) profiles would be required to test all possible treatment combinations, too many for an individual to assimilate. In order to reduce the number of profiles, a fractional factorial design was adopted which reduced the combinations to 27 (Kocur *et al.*, 1982). This fractional factorial design allowed for testing of

three two-factor interactions between attributes: diarrhoeal infection rate and polluted streams; diarrhoeal infection rate and cost of providing the service; and polluted streams and cost of providing the service. This design was adopted as a result of findings of the survey in Kampala, in which these attributes were found to be correlated. In order to avoid respondent fatigue, the experiment of 27 choice sets was divided into three, with each respondent shown nine choice sets, which is well within the recommended range of 9 to 15 choices (Humphreys, 2003; Pearce & Özdemiroglu, 2002).

Table 5-9: Two-level attributes used in the survey

Description (Unit of Measurement)	Shared Facilities		Yard Facilities	
	Low	High	Low	High
Reduction in the number of diarrhoeal infections (No. / 1000 people / month)	2.7	4.0	5.3	8.0
Number of school days saved (No. / 1000 children / month)	0.9	1.3	1.7	2.6
Reduction in pollution in rivers and streams (percent)	8	12	16	24
Savings on tax money spent by hospitals and clinics on treatment of diarrhoea (Rand / paying household / month)	4.6	6.9	5.9	8.8
The additional amount of money required from a middle income household (Rand / paying household / month)	11.85	17.77	20.99	31.48
The additional amount of money required from a high income household (Rand / paying household / month)	18.68	28.02	33.09	49.64

5.2.4 Description of survey instrument

Similar to the case of Kampala, the survey instrument applied in Cape Town was divided into three sections as described below (see Appendix C for questionnaire):

i. Section I, which aimed to recruit the respondent, explain the purpose of the survey, and check that the potential respondent met the survey criteria, i.e. the respondent did not live in an informal settlement and earned a household income above R3000 a month. The introduction section also provided information on the organisation conducting the survey and assured the respondents of the confidentiality of their answers.

ii. Section II, the main questionnaire, was divided into three parts:

- A section on attitudes and perceptions aimed at determining the relative importance and level of customer satisfaction with municipal services.
- The Choice Questions: The profiles constructed in the experimental design were arranged into choice pairs which were presented to the respondents. A "free choice" option was also posed, indicating a preference for the status quo.

- A Contingent Valuation Question to check for validity and consistency of responses. Since the only validation required was the value estimate, an open-ended willingness to pay question was posed and not a full CV questionnaire (Humphreys, 2003).

iii. Section III collected demographic information on the respondents.

5.2.5 Survey implementation and administration

5.2.5.1 Choice of valuation technique

Stated Preference (SP) techniques are the only suitable means of valuing non-use benefits (Pearce & Özdemiroglu, 2002). This study intended to identify the trade-offs that "non-poor" members of society were willing to make for improvements in levels of service of the poor. Choice experiments were the most appropriate option for presentation of the attributes under valuation. Similar to the case of Kampala, a contingent valuation question was included in the survey instrument. This would check for consistency in responses and identify any biases resulting from the choice experiment (Pearce & Özdemiroglu, 2002).

5.2.5.2 Target population

The City of Cape Town indigent policy provides a subsidy (for municipal services) to households with a monthly income below R2800 (Pollack, 2008). The target households for this study were therefore adopted as the non-indigent households that do not live in informal settlements and whose household income is above R2800 a month. According to the household expenditure profile for the city of Cape Town (see Appendix D), about half of the households in the city earn less than R2800 a month, implying a target population of 469,000 households (STATSA, 2009). The beneficiary population are the low income residents living in informal settlements and backyard shacks. As shown in Table 5-10 , an estimated total of 266,883 households live in informal settlements or backyard shacks (CoCT, 2009).

Table 5-10: CoCT water and sanitation customer profile

	As at 2009
Population	3,572,221
No. of Households	902,279
Formal housing excluding 150,000 backyard households	635,396
Informal housing	116,883
Backyard shacks	150,000
Total Beneficiary households (Informal housing + backyard shacks)	**266,883**

(CoCT, 2009)

5.2.5.3 Sampling strategy and implementation

This study presented the respondents with two improvement options (alternatives). In order to test for differences in preference between income groups, the target population was divided into two strata: respondents with household income between R3000 (2011 USD, 380) and R13,000 (2011 USD, 1646) per month, and respondents with household expenditure above R13,000 per month. The proportions of the "non-poor" population of Cape Town that lie within these strata are 30:70. As discussed in Chapter 3, the minimum recommended number of respondents for a survey of two alternatives should fall within the range of 100 to 200 in number. This study allowed for a 50% non-response rate and targeted a sample size of 300 respondents.

The survey was carried out in the CBD, Bellville and the Southern Suburbs of the city and targeted an equal proportion of male and female respondents. A consultancy company with survey experience in transport studies was employed to carry out the survey. A training session was held, during which the purpose of the survey and the survey instrument were explained to the enumerators. The enumerators were then required to carry out a practice session amongst themselves with one session as the interviewer and a second session as the interviewee. A question/answer session was held afterwards to share experiences and insights on the survey instrument. Based on their experience carrying out transport surveys, the enumerators recommended a maximum interview time of 30 minutes, beyond which respondent willingness to participate in the survey reduced. The enumerators also made recommendations on the structure of the questionnaire to ensure faster recording of information. The questionnaire was then piloted among a small sample (n=27) to test whether the questions were clear and comprehensible, and whether the interview time was within the desired time of 30 minutes per questionnaire. Implementation of the main survey was carried out over a six week period in September and October 2011.

5.3 Results

A total of 303 respondents were interviewed from 3 areas of Cape Town, *viz* the Northern suburbs, the CBD and the Southern suburbs. A description of the respondents' characteristics is summarised in Table 5-11.

5.3.1 Attitudes and perceptions

5.3.1.1 Importance of municipal objectives

The respondents were asked to rate the importance of a range of municipal objectives. As shown in Table 5-12, creation of job opportunities and delivery of housing to the poor were considered important by 100% of the respondents. Improving security and improving safety against fires were also ranked as important objectives by 99% and 98% of the respondents.

These ratings could be used to prioritise municipal management priorities in line with the expectations of the city residents.

Table 5-11: Socio-demographics of respondents

Total number in sample	303	
Age:	Above 65	14%
	21-64	86%
Employment Status:	Employed	70%
	Pensioner	16%
	Other	14%
Level of Education	Below Matric / Grade 12	18%
	Matric / Grade 12	55%
	Tertiary level	26%
Main income earner of household		78%
With members of household interested in social and environmental		76%
Income Levels	R3000-R6500	54%
	R6501-R13000	15%
	R13000-R26000	16%
	Above R26000	5%
	Do Not Know	2%
	Rather Not Say	7%

Table 5-12: Rating of municipal objectives

Focus Areas	Importance of Focus Area to Respondents				
	Very Important	Important	Slightly Important	Not Important	Not Sure
Increase opportunities for job creation (n=300)	67%	33%	0%	0%	0%
Improve delivery of housing to the poor (n=300)	66%	34%	0%	0%	0%
Improve security through law enforcement (n=300)	63%	36%	0%	0%	0%
Improve municipal services to your home e.g. water supply, solid waste collection, drainage (n=299)	60%	34%	6%	0%	0%
Improve social conditions with respect to drug abuse and gang-related activities (n=300)	61%	31%	7%	1%	0%
Improve safety against fires (n=300)	58%	40%	2%	0%	0%
Ensure proper management of the city with respect to proper staffing and good governance (n=300)	59%	34%	7%	0%	0%
Improve public transport (n=299)	51%	32%	12%	2%	3%

5.3.1.2 Satisfaction with municipal engineering services

The respondents who received full municipal engineering services were requested to rate their levels of satisfaction of a range of municipal engineering services. Over 90% of respondents were either very satisfied or satisfied with municipals services to their home (see Table 5-13). The services with which the respondents were least satisfied were the provision of public transport and provision of housing to the poor, with 8% and 27% respondents slightly or not satisfied respectively. The results of this exercise could be used as an indicator of potential areas that require improvement and as input to operational plans of the engineering department of the municipality.

Table 5-13: Satisfaction with municipal engineering services

Service Offered	Level of Satisfaction with the Service				
	Very Satisfied	Satisfied	Slightly Satisfied	Not Satisfied	Not Sure
Provision of water services to your house (n=303)	63%	36%	0%	1%	0%
Provision of sanitation to your house (n=302)	61%	37%	1%	1%	0%
Collection of solid waste from your house (n=301)	60%	37%	2%	1%	0%
Provision of street lighting in your neighbourhood (n=302)	60%	35%	4%	1%	0%
Provision of electricity to your house (n=302)	59%	38%	2%	1%	0%
Provision of storm water drainage from your house (n=302)	54%	38%	6%	2%	0%
Provision of roads to your house (n=302)	53%	39%	7%	1%	0%
Provision of public transport (n=302)	43%	43%	7%	1%	6%
Provision of housing to the poor (n=301)	38%	32%	22%	5%	2%

5.3.1.3 Prioritisation of water services

The respondents were asked to rate the importance of 11 objectives of water and sanitation departments, in the face of financial constraints. Generally, the water services that were related to the respondents' use were given a very high and high level of importance by over 90% of the respondents (Table 5-14). Environmental protection though adequate sewage treatment was also ranked as high by 97% of the respondents. In contrast, only about 80% of the respondents attached a high level of priority to services to informal settlements, with about 20% allocation to a fair and low level of priority.

These findings are similar to the results obtained from the survey in Kampala (Chapter 4), and suggest that the provision of services to the informal settlements will be prioritised lower

than the services to the respondents' homes, and to the respondent's concerns for the environment.

Table 5-14: Prioritisation of water services

Service Levels	Level of Priority				
	Very High	High	Fair	Low	Not Sure
Ensure 24 hour supply of water with no interruptions (n=303)	62%	36%	2%	0%	0%
Respond faster to fix leaks (n=293)	67%	29%	4%	0%	0%
Respond faster to customer queries (n=301)	65%	30%	5%	1%	0%
The accuracy of the water bills (n=301)	59%	38%	2%	1%	0%
Ensure adequate treatment of sewage to protect the environment (n=303)	53%	44%	2%	0%	0%
Provide advance warning in the event of service interruption (n=302)	56%	40%	4%	0%	0%
Ensure that the poor are provided with services at a price that they can afford	*45%*	*38%*	*16%*	*1%*	*0%*
Provide informal settlements with water and sanitation facilities closer to dwellings (n=301)	*46%*	*34%*	*18%*	*2%*	*1%*
Provide more than the current 10,000 litres of free basic water to poor households per month (n=301)	*45%*	*34%*	*19%*	*2%*	*1%*
Increase the level of community participation	36%	38%	23%	2%	0%
Provide water of lower quality for gardening and industrial cooling (n=301)	35%	36%	25%	3%	1%

5.3.2 The contingent valuation data

The respondents were requested to state their preference from a list of service levels to be provided to informal settlements. The respondents were also asked if they would be willing to pay for the installation of the level of service that they had selected, and state the amount that they would be willing to pay. In order to deconstruct motives, the respondents were requested to state the reason for their willingness to pay.

5.3.2.1 Preference for levels of service

The most preferred service level was yard facilities, chosen by 65% of the respondents. 33% of the respondents preferred shared facilities while 2% opted to retain the status quo (see Figure 5-8). Comparing these findings with the results of the choice experiment reveals a difference in the order of preference for level of service between the two elicitation methods. In

the choice experiment, 19%, 55%, and 27% of the respondents chose to install communal, shared and yard facilities respectively. Studies have found that contingent valuation and choice experiments can sometimes lead to different outcomes, attributed to differences in measurement scale and possible violations of the independence of alternatives assumption of choice models (Merino-Castello, 2003).

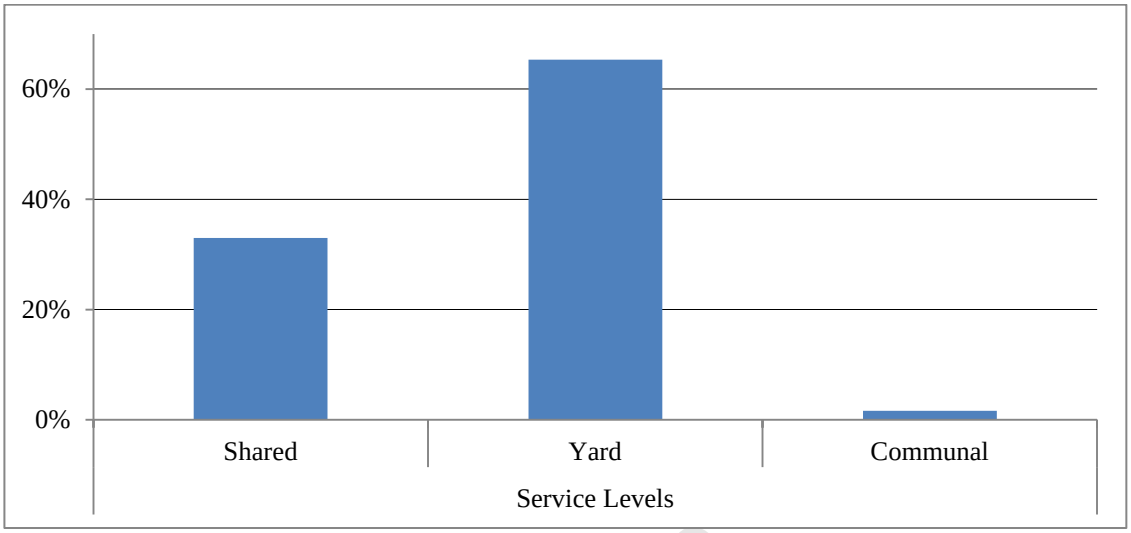

Figure 5-8: Preference for service levels (n=303)

5.3.2.2 Willingness to pay

57% of the respondents stated that they were willing to pay towards service level improvements in informal settlements. 21% of the respondents stated that they may be willing to pay, depending on several conditions such as *inter alia*, availability of funds, or if assured that the facilities would not be vandalised. 19% of the respondents were not willing to pay and 2% of the respondents did not state a willingness to pay value (see Figure 5-9).

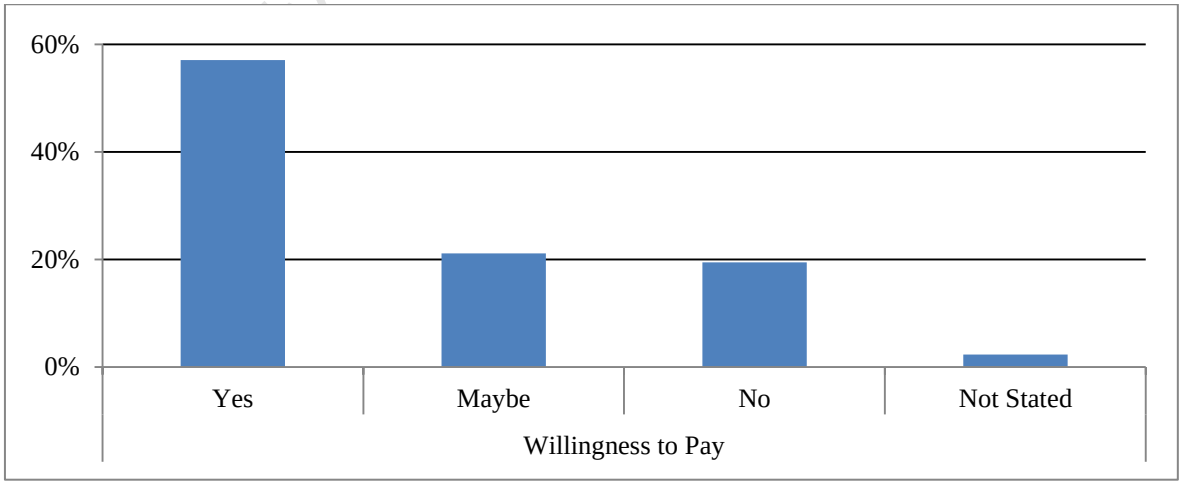

Figure 5-9: Percentage of respondents that were willing to pay (n=303)

Whittington (1996) provides guidelines on treatment of protest bids (respondents that do not state a willingness to pay value) and conditional willingness to pay statements. Such responses are all taken as indications of not being willing to pay, i.e. value of zero WTP. The average willingness to pay of all the respondents was R33 per household per month. The average willingness to pay value, based on 57% of respondents who indicated "yes" to the willingness to pay question was R42 per household per month (see Figure 5-10).

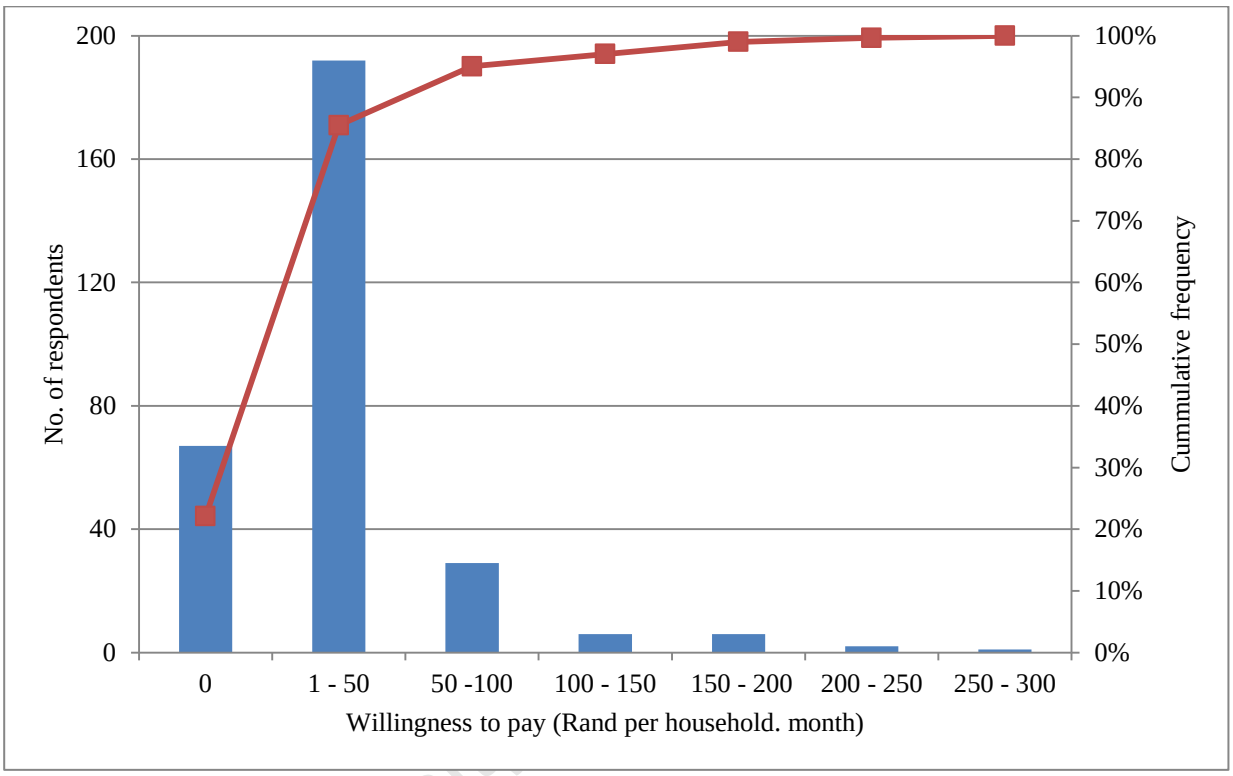

Figure 5-10: Willingness to pay for service level improvements

5.3.2.3 Reasons for willingness to pay

Figure 5-11 shows that 63% of the 173 respondents that reported that they were willing to pay did not give a reason for their willingness to pay. 14% were willing to pay for altruistic reasons such as helping the poor; 8% of the respondents were willing to pay for "feel good" reasons, citing that they would like to pay because they can afford it, and in some cases citing that it feels good to be helping others; 7% of the respondents reported that they would be willing to pay, but with conditions such as institutional transparency in management of the funds, the users did not abuse the facilities, or that the informal settlement is not developed in their neighbourhood; 6% of the respondents reported social motives such as willingness to pay to improve living conditions of the poor; improve conditions of children or encourage development of the area; 1% of the respondents stated that they were willing to pay for ethical reasons citing "no one should live like that"; while another 1% cited indirect use benefits, e.g. "it will help me".

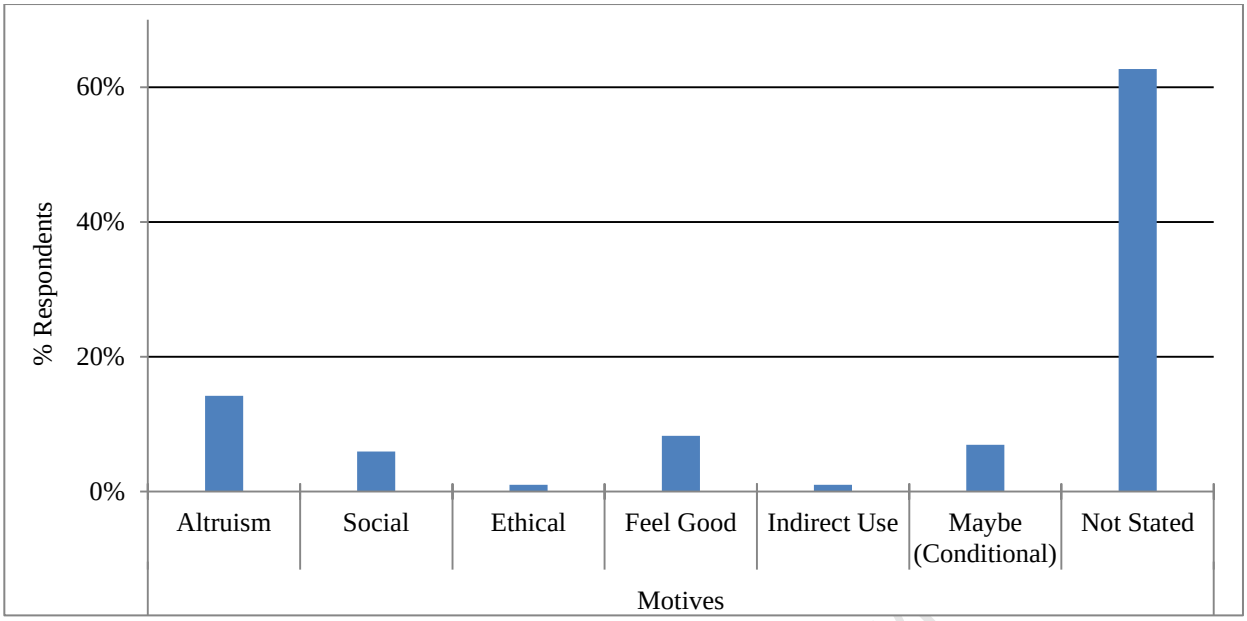

Figure 5-11: Reasons for willingness to pay(n=173)

5.3.3 The choice experiment

The choice experiment involved the presentation of nine randomly assigned choice sets to each respondent. Each of the choice sets involved a description of the current state of services, a description of two improvement options, including level of service costs and benefits and a request to choose which package they preferred as an intervention to improve services in informal settlements. The respondents were also presented with the option of not choosing either of the two alternatives, thereby choosing to retain the status quo. An example of the questions posed to the respondents is shown in Figure 5-12.

The experimental design was prepared as a labelled experiment, i.e. the level of service improvement was described to the respondents separately from the attributes required for the trade-off. The use of labelled experiments was utilised to allow for estimation of an alternative-specific constant (β_{0i}) in the utility model. A model containing the alternative specific constant would enable the comparison of the value of the level of service, in relation to the perception of the value attributes being traded off.

Currently, 3 out of 10 households share a water tap and use shared chemical toilets or bucket latrines. The impacts of this are that every month, 4 out of 100 people will suffer from diarrhoea and 11 out of 1000 children will miss school.

The government will spend about 13 Rand of your household's tax money on treatment of diarrhoea every month and 30% of rivers will not comply with recreation and fishing standards. The tables infront of you describe 2 possible improvement scenarios.

The tables also describe different costs and benefits associated with each improvement. Suppose you were required to choose, which would be your preferred scenario to implement?

10 (a)

	Scenario 1		Scenario 2	
The proposed improvement is	**1 tap per household and a shared flush toilet for every 5 households**		**1 tap and a flush toilet in the yard of every household**	
Will reduce the number of diarrhoeal infections (out of 1000 people) by	2.7	fewer infections per month	5.3	fewer infections per month
For every 1000 children, will save	0.9	school days a month	2.6	school days a month
Will reduce the number of polluted rivers by	8	(for every 100 rivers and streams in the city)	16	(for every 100 rivers and streams in the city)
The amount of saving on your household's tax money that is spent on medical care for diarrhoea shall be	R 4.59	saved per month	R 8.82	saved per month
To implement this scenario, your household shall be required to pay	R 18.68	per month	R 33.09	per month
The informal settlement to be improved is located	In another province of South Africa		Near your neighbourhood	
Your payment shall be collected as part of	Your local property tax bill		A special fund set up for this purpose	

9 7 Please tick against your preferred scenario: Scenario 1 [ ] OR Scenario 2 [ ]

10 (b) If you could opt out of choosing, would you still choose your preferred scenario above? YES [ ] OR NO [ ]

Figure 5-12: Example choice question

Table 5-15 shows the parameters estimated by the model and their expected sign.

Table 5-15: Estimated parameters and expected sign

Variable and notation used in model	Unit of Measurement	Expected Sign
Location of Informal Settlement to be improved (LOC)	1= location offered, 0 otherwise	?
The means through which payment may be collected (PV)	1= payment option offered, 0 otherwise	?
Reduction in the number of diarrhoeal infections per month (DIR)	Continuous(No. /1000 people. month)	+
Number of school days made available per month (SDL)	Continuous (No. /1000 children. month)	+
The percentage of rivers and streams that will comply with recreation and fishing quality standards (POL)	Continuous(No. of rivers and streams out of 100)	+
Savings on tax money spent by hospitals and clinics on treatment of diarrhoea per taxpaying household (COD)	Continuous(R per household per month)	+
Additional amount of money required to provide this level of service (COST)	Continuous(R per household per month)	-

The respondents were requested to choose an improvement from the status quo to either shared facilities (LOS 1) or to yard facilities (LOS 2). The respondents were then given the option not to choose either improvement. When given this option, 18.4% of the respondents chose not to install any of the two improvement facilities. The effect of offering the respondents the option of a free choice is shown in Table 5-16. Under forced choice conditions, the option to install shared facilities was chosen in 66% of the cases. However when given the option, 15.7% of the respondents opted to retain the status quo. Among the respondents that chose to install yard facilities under the forced choice conditions, 23.6% of the respondents chose to retain the status quo when given the option.

Table 5-16: Distribution of respondent choices

Scenario	Forced choice	Free choice	
		Choose an improvement	Retain status quo
Shared facilities (LOS 1)	1800	1517 (84.3%)	283 (15.7%)
Yard facilities (LOS 2)	927	708 (76.4%)	219 (23.6%)
Grand Total	**2727**	**2225**	**502**

5.3.3.1 The basic multinomial logit model

The basic multinomial logit (MNL) model, estimated for the data, is illustrated in Table 5-17. The parameter estimates for the reduction in diarrheal infection rate, the school days saved and reduction in tax cost of diarrhoea all had the wrong sign (see Table 5-15 for expected signs for each variable). Furthermore, the parameter estimates for the payment vehicle, reduction in diarrheal infection, reduction in pollution and reduction in tax cost of diarrhoea were all not statistically significant contributors to the model output. In an attempt to improve the model fit, six multinomial logit (MNL) models were tested, including models with interaction effects, as summarised below:

i. A forced choice basic MNL model with alternative specific constant (ASC).

ii. A forced choice basic MNL model with no alternative specific constants.

iii. A forced choice basic MNL model with no alternative specific constants and with the cost variable transformed to a variable representing the cost divided by income (MCost).

iv. A free choice basic MNL model.

v. A free choice basic MNL model with the cost variable transformed to a variable representing the cost divided by income (MCost).

vi. A free choice basic MNL model with interaction terms.

Table 5-17: Parameter Estimated for the Basic Multinomial Logit Model

No. of Observations	2727.00			
Log Likelihood (Base)	-2995.92			
Log Likelihood (Model)	-2605.47			
Adj Rho-squared	0.13			
	Coeff.	**Std.Err.**	**t-ratio**	**P-value**
Alternative specific constant for shared facilities (LOS 1)	1.58	0.24	6.59	0.00
Alternative specific constant for yard facilities (LOS 2)	1.29	0.41	3.13	0.00
Informal settlement located near respondent's neighbourhood	0.47	0.07	6.92	0.00
Informal settlement located in another suburb of Cape Town	-0.13			
Informal settlement located in another province of SA	-0.34	0.08	-4.34	0.00
Pay through municipal bill	0.11	0.08	1.37	0.17
Pay through local property tax	-0.08	0.07	-1.23	0.22
Pay through special fund	-0.03			
Reduction in diarrhoeal infection rate	-0.01	0.03	-0.50	0.62
Savings in school days lost due to diarrhoea	-0.14	0.09	-1.45	0.15
Reduction in pollution of rivers and streams	0.004	0.01	-0.31	0.75
Reduction in tax money spent by health agencies on diarrhoea	-0.02	0.02	-0.75	0.46
Cost/income	-114.17	28.56	-4.00	0.00

The model output of the six estimations is shown in Table 5-18. Comparison of the log likelihoods and of the signs of the individual parameter estimates shows that inclusion of interaction effects did not significantly improve the model. Attempts to merge the other correlated variables into one variable did not improve the model fit either.

Multicollinearity in an MNL model is said to exist when independent variables are correlated, and the assumption of independence and identical distribution of the variables has been violated. The impact of multicollinearity is that variances of the parameter estimates are inflated and this results in variables with low statistical significance (although the overall model significance may not be affected). Multicollinearity may also result in wrong sign and magnitude of parameter estimates. The experimental design allowed for the testing of interactions between: diarrhoeal infection rate and pollution level; diarrhoeal infection rate and cost of intervention; and pollution level and cost of intervention. Examination of the correlation matrix revealed correlation between some of the variables that had not been allowed for in the experimental design as follows: school days saved and diarrhoeal infection rate; savings in tax money spent on diarrhoea and diarrhoeal infection rate; and location of informal settlement near respondent's neighbourhood and in another suburb of Cape Town (see Appendix E). It was thus decided to apply a model such as the nested logit model that relaxes the IID condition of the MNL.

Table 5-18: Basic MNL Models Tested

Model	**Forced Choice Model**			**Free Choice Model**		
Description	**MNL (ASCs)**	**MNL**	**MNL (Mcost)**	**MNL**	**MNL (Mcost)**	**MNL (Interact)**
No. of observations	2727	2727	2727	2727	2727	2727
LL base	-1890.21	-1672.15	-1666.59	-2995.92	-2995.92	-2995.92
LL model	-1668.91	-1890.21	-1890.21	-2613.52	-2605.46	-2602.20
Adj Rho squared	0.11	0.11	0.12	0.13	0.13	0.13
Chi sq. (degrees of freedom)	158.16(9.00)		162.80 (9.00)	160.92(9.00)	177.03(9.00)	183.57(11.00)
	Coeff. (t-ratio)	**Coeff. (t-ratio)**	**Coeff. (t-ratio)**	**Coeff. (t-ratio)**	**Coeff. (t-ratio)**	**Coeff. (t-ratio)**
ASC – Shared facilities	0.50 (2.56)		0.26 (1.35)	1.45 (5.96)	1.58 (6.59)	1.48 (7.15)
ASC – Yard facilities				1.09 (2.60)	1.29 (3.13)	1.17 (3.46)
Informal settlement located near respondent's neighbourhood	0.42 (6.18)	0.44 (6.49)	0.36 (5.30)	0.48 (7.10)	0.47 (6.92)	0.47 (6.90)
Informal settlement located in another suburb of Cape Town	-0.01	-0.05	0.06	-0.14	-0.13	-0.14
Informal settlement located in another province of SA	-0.41 (-4.98)	-0.39 (-4.73)	-0.42 (-5.18)	-0.34 (-4.29)	-0.34 (-4.34)	-0.33 (-4.13)
Pay through municipal bill	0.06 (0.74)	0.06 (0.72)	0.13 (1.58)	0.10 (1.24)	0.11 (1.37)	0.11 (1.46)
Pay through local property tax	-0.11 (-1.67)	-0.10 (-1.52)	-0.01 (-0.16)	-0.10 (-1.50)	-0.08 (-1.23)	-0.07 (-1.02)
Pay through special fund	0.05	0.04	-0.12	0	-0.03	-0.04
Reduction in diarrhoeal infection rate	-0.01 (-0.51)	-0.05 (-2.08)	0.01 (0.37)	-0.02 (-0.77)	-0.01 (-0.50)	-0.01 (-0.40)
Saving in school days lost due to diarrhoea	-0.29 (-3.13)	-0.41 (-4.93)	-0.13 (-1.42)	-0.18 (-1.91)	-0.14 (-1.45)	-0.17 (-1.25)
Reduction in pollution of rivers and streams	0.00 (-0.40)	-0.03 (-2.87)	0.00 (0.24)	-0.01 (-0.49)	0.00 (-0.31)	
Reduction in tax money spent by health agencies on diarrhoea	-0.02 (-0.79)	-0.03 (-1.20)	-0.03 (-1.19)	-0.02 (-0.69)	-0.02 (-0.75)	0.00 (-0.11)
Cost or *MCost(MCost=Cost/income)	0.02 (3.34)	0.02 (2.86)	-150.73* (-3.92)	0.00 (-0.33)	-114.17* (-4.00)	-113.98* (-3.97)
Interaction between diarrhoeal infection rate and pollution level						0.01 (1.41)
Interaction between cost and pollution level						0.00 (2.10)
Interaction between cost and diarrhoeal infection rate						0.00 (0.43)

5.3.3.2 Application of the nested model to the Cape Town data

The data exhibited correlation between the two improvement options. The data was thus analysed as a Nested Logit (NL) model using the LIMDEP program. Alternative nested structures were investigated based on a combination of logical outcomes and *a priori* judgement of potential sources of unobserved correlations between alternatives. Figure 5-13 and Figure 5-14 show two alternative nested structures as described below.

The first alternative was to choose between improving the level or service and retaining the status quo. The status quo (SQ) is a degenerative alternative (since it contains only one option, the communal facilities). The option to install an improved level of service (IMPROVE) was a nest comprising of the 2 improvement options shared facilities (LOS 1) and yard facilities (LOS 2).

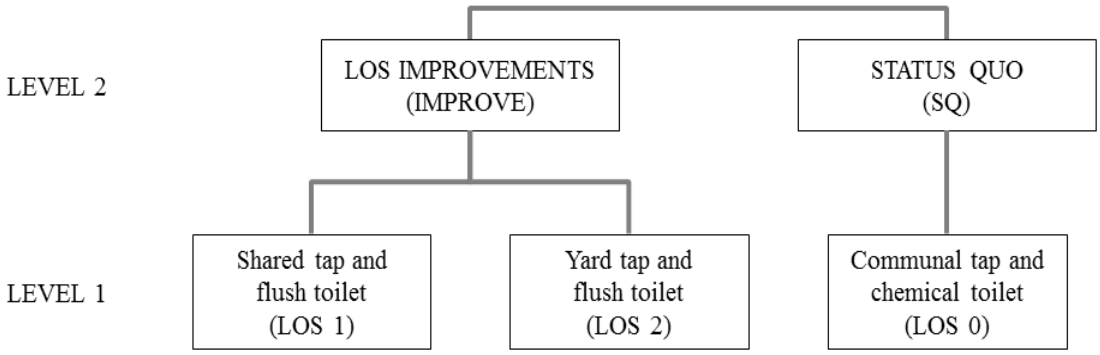

Figure 5-13: Plausible nested structure I

The second alternative was to choose between providing water and sanitation facilities to be shared between households and water and sanitation facilities to each beneficiary household. The option to provide shared facilities (SHARED) comprised of communal taps and chemical toilets (LOS 0) and taps and a flush toilet shared between 5 households (LOS 1) under one nest and facilities used by one household (OWN), located in the household yard (LOS 2) as a degenerative alternative.

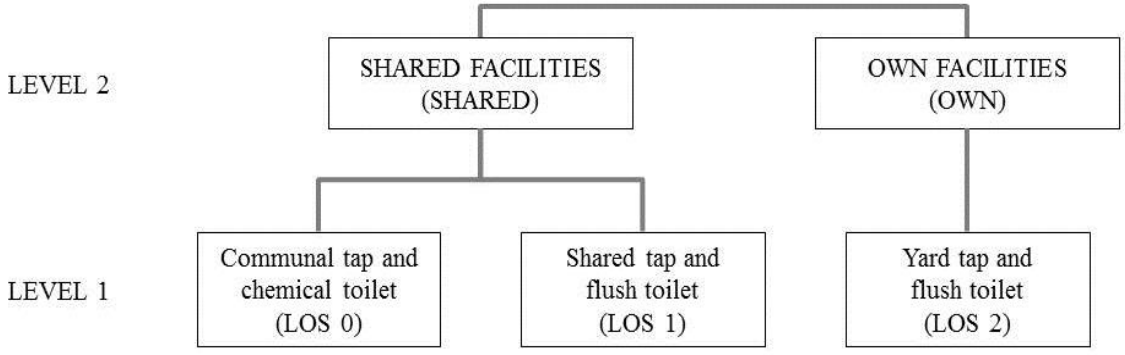

Figure 5-14: Plausible nested structure II

The outputs of the two models are shown in Table 5-19. The correlation matrix revealed that the attributes representing the health agency cost of diarrhoeal treatment (COD) and school days lost (SDL) were correlated to cost. The variables consequently did not produce expected results and were excluded from the models.

In order to compare the two models, the log likelihood (LL) ratio and the chi square were evaluated using guidelines from Koppelman & Bhat (2006) and Hensher *et al.* (2005) as follows:

- The log likelihood (LL) ratio test indicates whether the nested model is an improvement from a base model estimated with constants only (i.e. the explanatory variables are not used in model estimation). A nested model that is an improvement from the base model will result in a log likelihood value that is lower than the log likelihood value of the base model. As shown in Table 5-19, the log likelihood of the two nested models was lower than the log likelihood of the base model. The difference between log likelihood values of the Nested Structure I (SQ:IMPROVE) was however higher than the difference between the log likelihood values for the Nested Structure II (OWN:SHARED), indicating that the Nested Structure I provided a better nested model.
- The chi-square represents the difference between the nested model and the base model. The chi-square was compared to a critical chi-square value (no. of parameters estimated plus two IV parameters) with degrees of freedom. Both models show an improved goodness-of-fit relative to the base model; the chi-square tests on both models are significant to the 5% level. A significance value that is less than 5% indicates that the estimated model improves the log likelihood function of the base model (model that is estimated with constants only). It can thus be said that the parameter estimates for the attributes of the two nested models improve the overall model fit.
- The rho-squared value, which explains the degree of variability in the model. In logit models, an adjusted rho-squared of between 0.2 and 0.4 is considered an acceptable model fit. Comparing the two nested models, the Nested Structure I (SQ:IMPROVE) has a higher rho-squared value and can therefore be said to provide a better model fit than Nested Structure II (OWN:SHARED).
- The IV parameterλ, is a function of the correlation between the unobserved influences among the alternatives, and is an indication of the suitability of the nested structure in explaining the variability in the respondents' choices. As explained in Chapter 2, in order to meet utility maximisation criteria, the IV parameter should range from zero to one. There are two tests used to check this:
    - The IV parameters for the two nested models passed the 5% significance level. A p-value that is significant to the 5% level means that the IV parameter λ, used to define the nests is not equal to zero.

Table 5-19: Possible nested models for Cape Town data

Nested Structure:	**I (SQ:IMPROVE)**			**II OWN:SHARED)**	
Log Likelihood (Base)	-3432.46			-3289.68	
Log Likelihood (Model)	-2491.56			-2564.73	
Adjusted Rho-squared	0.27			0.22	
Chi-sq. (Significance to the 5% level)	1881.80 (0.00)			1449.89 (0.00)	
Degrees of Freedom	19.00			19.00	
	Coeff. (t-ratio)	**Std Error**		**Coeff. (t-ratio)**	**Std Error**
Informal settlement located near respondent's neighbourhood	0.53 (7.38)	0.072		0.49 (5.38)	0.090
Informal settlement located in another suburb of Cape Town	0.14			0.18	
Informal settlement located in another province of SA	-0.39 (-4.65)	0.084		-0.34 (-4.23)	0.081
Pay through municipal bill	0.19 (2.53)	0.074		0.18 (2.56)	0.071
Pay through local property tax	0.11 (1.45)	0.074		0.09 (1.32)	0.069
Pay through dedicated fund	-0.29			-0.27	
Reduction in diarrhoeal infection rate	0.32 (5.66)	0.057		0.02 (0.46)	0.045
Reduction in pollution of rivers and streams	0.12 (6.37)	0.02		0.01 (0.96)	0.015
Cost of installation	-0.02 (-3.42)	0.007		-0.01 (-1.64)	0.005
Interaction (diarrhoeal infection rate and pollution level)	-0.02 (-6.16)	0.004		-0.003 (-1.07)	0.003
Gender – Female	0.20 (2.22)	0.09		0.17 (1.74)	0.095
Employed	0.70 (5.89)	0.117		-0.65 (-6.26)	0.103
Pensioner	0.71 (4.64)	0.153		-0.76 (-5.62)	0.136
Other Employed (students, housewives)	-1.41			1.41	
Educated to Tertiary Level	0.54 (6.20)	0.088		-0.11 (-1.15)	0.093
Major Income Earner (Yes=1)	-0.33 (-3.40)	0.098		0.58 (4.87)	0.118
Household No.	0.12 (3.80)	0.031		-0.03 (-1.00)	0.025
Household interested in social, environmental issues (Yes=1)	-1.18 (-9.34)	0.127		0.13 (-1.35)	0.093
Income R3000 – R6500 / month	0.69 (5.34)	0.128		-0.48 (-4.44)	0.109
Income R6501 – R13,000 / month	0.57 (3.45)	0.167		-0.67 (-4.65)	0.145
Income R13,001 – R26,000 / month	-1.39			1.36	
Income above R26,000 / month	0.13 (0.91)	0.147		-0.21 (-1.52)	0.136
Degenerate Branch	1.00			1.00	
Nesting Coefficient (IV parameter)	0.84 (14.47)	0.058		0.98 (5.82)	0.231

- The standard t-tests are used to test whether the IV parameter is equal to one. As explained in Chapter 2, the Inclusive Value (IV) expresses the link between the branch and the elemental alternatives that exist under that branch. The IV parameter (λ/μ), relates the variance of the branch alternative (λ) to the variances of the elemental alternative (μ), thereby reflecting the degree to which the data can be explained by the nested structure. The implication of an IV parameter that is equal to one is that the variances of the branch alternative and the elemental alternatives are equal, and there is no requirement for a nested structure. The elemental alternatives are assumed to satisfy the conditions of an MNL model i.e. error terms are identical and independently distributed and $\mu = 1$. The null hypothesis (that the MNL model for the elemental alternatives is the correct model) is rejected if the calculated t-statistic is greater than a critical value for the distribution (Koppelman & Bhat, 2006).

$$\text{t-statistic} = \frac{\lambda\text{-}1}{S} \tag{5-2}$$

where λ is the IV parameter, and S is the standard error of the coefficient. The test statistic is compared to the critical value of |1.96| (at alpha =.05). If the value is lower than 1.96, one cannot reject the hypothesis that the IV parameter is statistically equal to one. A failed test implies that the two branches of the structure should collapse into a single branch.

The Nested Structure I (SQ:IMPROVE) passes this test, i.e. $\left(\frac{0.84-1}{0.058}\right) > |1.96|$.

The Nested Structure II (OWN:SHARED) fails this test, i.e. $\left(\frac{0.98-1}{0.23}\right) < |1.96|$.

The selected model structure was the Nested Structure I (SQ:IMPROVE), and consisted of a 2-level tree, nested into the choice to install improvements as a branch, with the two level of service alternatives at the elemental level, and the choice to retain the status quo as a degenerative branch as shown inFigure 5-15.

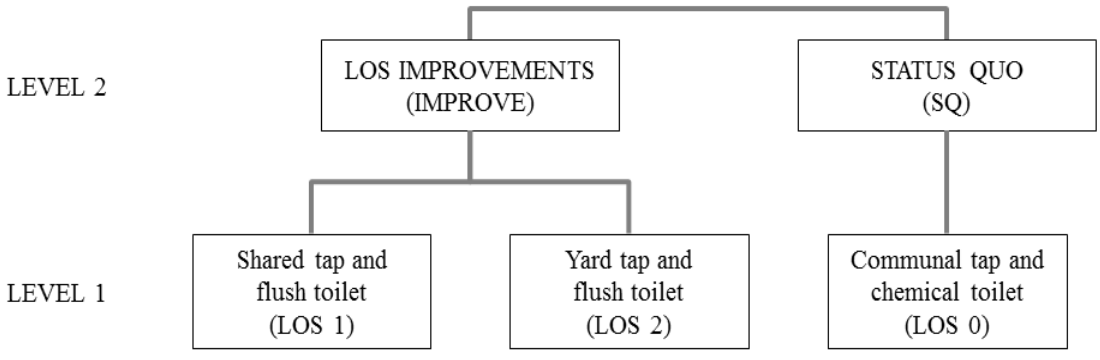

Figure 5-15: Nested tree structure for the Cape Town data

At the lowest level of the tree structure (Level 1), the utility equation for the elemental alternatives is as shown below:

$$V_{LOS} = \beta_1 * DIR + \beta_2 * POL + \beta_3 * COST + \beta_{41} * PV_{(BILL)} + \beta_{42} * PV_{(TAX)} + \beta_{43} * PV_{(FUND)} + \beta_{51} * LOC_{(NEIGHBOURHOOD)} + \beta_{52} * LOC_{(SUBURB)} + \beta_{53} * LOC_{(PROVINCE)} \quad (5\text{-}3)$$

$$V_{SQ} = \beta_1 * DIR + \beta_2 * POL + \beta_3 * COST \quad (5\text{-}4)$$

where β are the parameter estimates; PV are the alternative payment mechanisms corresponding to municipal bill, property taxes and special fund; and LOC are the locations of informal settlement to be improved, corresponding to near the respondents' neighbourhood, in another suburb of Cape Town and in another province of South Africa.

The probability of selecting the elemental alternatives within the branch is illustrated below:

$$P(LOS) = \frac{e^{(V_{LOS1})}}{e^{(V_{LOS1})} + e^{(V_{LOS2})}} \quad (5\text{-}5)$$

The alternative SQ is the only alternative that may be chosen within the branch. Within this branch therefore, the probability of selecting the SQ option is one, i.e.

$$P(SQ) = \frac{e^{V_{SQ}}}{e^{V_{SQ}}} = 1 \quad (5\text{-}6)$$

The highest level in the nested tree represents a choice between retaining the status quo and installing an improvement option. This implies a marginal choice between the LOS improvement and the status quo and a conditional choice between LOS 1 and LOS 2, given that the "IMPROVE" option has been chosen. The utility functions for the level of service improvement options contain a combination of deterministic and random components that is unique to the alternative (LOS 1 or LOS 2) and a deterministic and random component that is common to both levels of service, arising from the similarity between the 2 alternatives.

One requirement of the nested logit model is that the total variance for each option be fixed, and that the variance at each level of the tree be positive. Similar to the MNL model, the total error for the alternatives is assumed to be Gumbel distributed with variance arbitrarily set to one. This means that the error variance at each level of the tree must be lower than the next higher level (as illustrated in Figure 5-16). For the 2-level tree structure adopted in this study, the error components are estimated with scale parameter $\lambda_{IMPROVE}$ bounded by zero and one to ensure that the conditional variance for the total error components for each option is non-negative (Koppelman & Bhat, 2006).

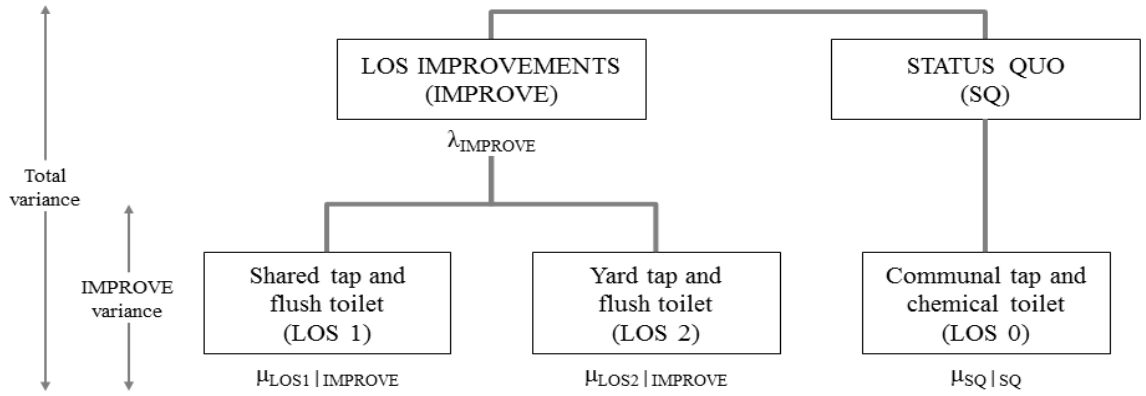

Figure 5-16: Error variances and scale parameters in nested structure

Normalising the scale parameter$\mu_{LOS1|IMPROVE} = \mu_{LOS2|IMPROVE} = 1$, would give the estimated models the form:

$$V_{IMPROVE} = \lambda_{IMPROVE}(IV_{IMPROVE}) \quad (5\text{-}7)$$

where $IV_{IMPROVE} = \ln\left(e^{(V_{LOS1})} + e^{(V_{LOS2})}\right)$

Since the attributes for the SQ option were specified at Level 1, they are excluded from this equation. The utility function for the SQ option at the Branch Level (BSQ) thus becomes:

$$V_{BSQ} = \lambda_{SQ}\left(\frac{1}{\mu_{SQ}} * IV_{SQ}\right) \quad (5\text{-}8)$$

For$\mu_{SQ} = 1$, and $IV_{SQ} = \ln(e^{\mu_{SQ}V_{SQ}}) = V_{SQ}$

$$V_{BSQ} = \lambda_{SQ} * V_{SQ} \quad (5\text{-}9)$$

The probability of selecting the composite alternatives is illustrated below:

$$P(BSQ) = \frac{e^{V_{BSQ}}}{e^{V_{IMPROVE}} + e^{V_{SQ}}} \quad (5\text{-}10)$$

$$P(IMPROVE) = \frac{e^{V_{IMPROVE}}}{e^{V_{IMPROVE}} + e^{V_{SQ}}} \quad (5\text{-}11)$$

The probability of selecting an elemental alternative is conditional on selection of the branch under which it belongs. In this case, the probability of choosing to install shared facilities (LOS 1) is contingent on choosing an improvement option as illustrated below:

$$P(LOS\ 1|IMPROVE) = P(LOS\ 1) * P(IMPROVE) \quad (5\text{-}12)$$

$$P(LOS\ 1|IMPROVE) = \frac{e^{(V_{LOS1})}}{e^{(V_{LOS1})} + e^{(V_{LOS2})}} * \frac{e^{V_{IMPROVE}}}{e^{V_{IMPROVE}} + e^{V_{SQ}}} \quad (5\text{-}13)$$

Similarly, the probability of choosing to install yard facilities (LOS 2) is contingent on choosing an improvement option.

$$P(\text{LOS 2}|\text{IMPROVE}) = P(\text{LOS 2}) * P(\text{IMPROVE}) \quad (5\text{-}14)$$

$$P(\text{LOS 2}|\text{IMPROVE}) = \frac{e^{(V_{LOS2})}}{e^{(V_{LOS1})} + e^{(V_{LOS2})}} * \frac{e^{V_{IMPROVE}}}{e^{V_{IMPROVE}} + e^{V_{SQ}}} \quad (5\text{-}15)$$

5.3.4 Analysis of the stated preference data

The choice proportions as they appear in the Stated Preference (SP) data are given in Table 5-20. At the branch level, it can be seen that the status quo option (LOS0) represents 18.4% of the choices while the option to install an improved level of service was chosen in 81.6% of the cases. At elementary alternative level, retention of communal facilities (LOS0) was chosen in 18.4% of the cases (this is a degenerative branch of the nested tree); shared (LOS1) and yard (LOS2) facilities were chosen in 55.6% and in 25.9% of the cases respectively.

Table 5-20: Choices in the Dataset

Limb (prop.)	Branch (prop.)		Choice (prop.)	
Limb [1|1] 1.00	SQ	18.41%	Communal facilities	18.41%
	OTHER	81.59%	Shared facilities	55.63%
			Yard facilities	25.96%

The coefficients and willingness to pay estimates are shown inTable 5-21.The table includes the model output and calculations for the coefficients for the dummy coded variables that were excluded during the model specification (a requirement that allows for variability in order to estimate the coefficients). The willingness to pay estimates are the ratio of the coefficient of each variable to the coefficient of cost and represent the willingness to pay for a unit benefit as described by the attribute. Attempts to estimate alternative specific constants (ASCs) did not produce the expected results. In addition to the ASCs having low statistical significance, there was also no significant difference in magnitude between the ASCs for the 2 improvement options. This could mean that respondents' preferences were based on the attribute characteristics and not the labels. The model was thus estimated without ASCs. All other coefficients exhibited the sign and magnitude as expected (see Table 5-15 for expected signs).

Detailed interpretation of the model output is given below:

- The coefficients for the location of the informal settlement to be improved indicated that the respondents' order of preference is towards an informal settlement that is located nearest to their neighbourhood, followed by an informal settlement that is located in another suburb of Cape Town and lastly an informal settlement that is located in another province of South Africa.

The respondents are willing to pay: R23.72 per month towards improving levels of service in an informal settlement that is located nearest to their neighbourhood; R17.31 per month towards an informal settlement that is located in another suburb of Cape Town and R6.4 towards an informal settlement that is located in another province of South Africa.

Table 5-21: Coefficients and willingness to pay estimates

Attributes	Coeff.	t-ratio	P-value	WTP Estimate
Informal settlement near respondent's neighbourhood	0.534	7.41	0.00	23.72
*Informal settlement located in another suburb	-0.144			17.31
Informal settlement located in another province of SA	-0.390	-4.64	0.00	6.40
Pay through municipal bill	0.188	2.54	0.01	8.34
Pay through local property tax	0.106	1.46	0.14	4.73
*Pay through dedicated fund	-0.294			-13.07
Reduction in diarrhoeal infection rate	0.318	5.63	0.00	14.13
Reduction in pollution of rivers and streams	0.124	6.35	0.00	5.52
Cost	-0.023	-3.41	0.00	
Interaction between diarrhoeal infection rate & pollution	-0.022	-6.16	0.00	-0.98

*Author's calculation

- The coefficients for the payment option through local property tax failed the statistical significance test (with a p-value = 0.14). The attributes for the payment mechanism were entered into the model as a dummy variable. This resulted in the coefficients for each payment option being estimated relative to one of the other payment options (to allow this to happen, one attribute is normally excluded from the model estimation). A lack of statistical significance of one option, as was the case with the coefficient for the option to pay through local property tax bill, means that there is no statistical difference between the option to pay through local property taxes and the option to pay through a dedicated fund (this was the dummy variable that was excluded to allow for estimation of the coefficients).

  The output for the payment method indicated that the respondents' highest preference is towards the option to pay through the municipal bill valued at R8.34 per month, followed by the option to pay through local property tax valued at R4.73 per month and lastly the option to pay through a dedicated fund.

- The coefficient for the reduction in diarrhoeal infection indicates positive utility as the diarrhoeal infection rate reduces. The value of the utility is R14.31 per month towards a unit reduction in diarrhoeal incidences among 1000 people / month. Based on the proposed reduction of 3.3 diarrhoeal incidences / month (associated with shared facilities), and 6.7 diarrhoeal incidences / month (associated with yard facilities), the willingness to pay for

the health benefits of improving levels of service is R4.28 per month towards installing shared facilities and R2.11 per month towards installing yard facilities.

- The respondents experienced positive utility towards reducing the levels of pollution in rivers and streams, valued at R5.52 per month for a unit reduction in pollution levels. Based on the proposed reduction of 10% (associated with shared facilities), and 20% (associated with yard facilities), the willingness to pay for the environmental benefits of improving levels of service is R55.20 per month towards installing shared facilities and R27.60 per month towards installing yard facilities. The interaction term between the reduction in diarrhoeal infection and in pollution levels accounts for the links between pollution and diarrhoeal infection, i.e. reducing pollution in rivers and streams may lead to a reduction in disease outbreaks, which may have influenced the respondents' ability to trade off the two variables.

The estimated models for the level of service alternatives are as shown below:

$$V_{LOS1} = 0.318 * DIR + 0.124 * POL - 0.023 * COST + 0.188 * PV_{(BILL)} + 0.106 * PV_{(TAX)} - 0.294 * PV_{(FUND)} + 0.534 * LOC_{(NEIGHBOURHOOD)} - 0.144 * LOC_{(SUBURB)} - 0.390 * LOC_{(PROVINCE)} \quad (5\text{-}16)$$

$$V_{LOS2} = 0.318 * DIR + 0.124 * POL - 0.023 * COST + 0.188 * PV_{(BILL)} + 0.106 * PV_{(TAX)} - 0.294 * PV_{(FUND)} + 0.534 * LOC_{(NEIGHBOURHOOD)} - 0.144 * LOC_{(SUBURB)} - 0.390 * LOC_{(PROVINCE)} \quad (5\text{-}17)$$

$$V_{SQ} = 0.534 * DIR + 0.124 * POL - 0.023 * COST \quad (5\text{-}18)$$

where V_{LOS1} represents the utility, *V* that the respondent receives from the alternative to install shared facilities; V_{LOS2} represents the utility that the respondent receives from the alternative to install yard facilities; and the attributes: DIR represents the reduction in diarrhoeal incidence; COD represents the reduction in health agency cost of diarrhoeal treatment; $PV_{(BILL)}$ represents payment through the water bill; $PV_{(TAX)}$ represents payment through the central government taxes; $PV_{(FUND)}$ represents payment through a dedicated fund; $LOC_{(NEIGHBOURHOOD)}$ represents an informal settlement located near the respondent's neighbourhood; $LOC_{(SUBURB)}$ represents an informal settlement located in another suburb in Cape Town; and $LOC_{(PROVINCE)}$) represents an informal settlement located in another province in South Africa.

The estimated model for the choice to improve the levels of service is as shown below:

$$V_{IMPROVE} = 0.84 * (IV_{IMPROVE}) \quad (5\text{-}19)$$

where $V_{IMPROVE}$ represents the utility, *V* that the respondent receives from choosing to improve levels of service (as opposed to retaining the status quo); the IV

parameter, $IV_{IMPROVE} = \ln\left(e^{(V_{LOS1})} + e^{(V_{LOS2})}\right)$ and V_{LOS1} and V_{LOS2} are defined in equation 5-16 and equation 5-17.

5.3.4.1 Influence of social demographic characteristics

The influence of the social demographic characteristics of the respondents on the model output is shown in Table 5-22.

Table 5-22: Influence of socio demographic characteristics

Attributes	Coeff.	t-ratio	P-value	Relative WTP
Gender – Female	0.20	2.25	0.02	8.97
Employment Status = Employed	0.70	5.95	0.00	31.60
Employment Status = Pensioner	0.71	4.66	0.00	30.99
*Employment Status = Other, housewife, student	-1.41			
Educated to Matric Level	0.55	6.27	0.00	24.42
Major Income Earner of the household (Yes = 1)	-0.32	-3.31	0.00	-14.28
Household Size	0.12	3.90	0.00	5.28
Household is interested in social & environmental issues	-1.17	-9.33	0.00	-51.82
Income R3000 – R6500 / month	0.63	5.69	0.00	27.91
Income R6501 – R13,000 / month	0.51	3.37	0.00	22.74
Income above R13,001 / month	-1.14			

*Author's calculation

Willingness to pay varied across the different socio-demographic groups as discussed below:

- The respondents that were educated up to matric level and above were more willing to pay than those educated below matric (Grade 12). The employed and the pensioners showed equal willingness to pay, at an estimated R31.60 and R30.99 per month more than the "other" category (consisting of students, housewives) respectively.
- When the respondent was the main income earner of the household, willingness to pay reduced by R14.28 per month.
- Willingness to pay increased with increasing household size. However the utility value for households with members interested in social and environmental issues was negative. The *a priori* expectation would be that households with members that engage in social and environmental activities would exhibit a positive utility towards improving water and sanitation conditions in informal settlements.

- Females were more willing to pay towards a level of service improvement. Compared to the males, females were willing to pay R8.97 per month to effect an improvement.
- The results also show that the higher the income group, the less the respondent was willing to pay. Households with an average household income between R3000 and R6500 per month were willing to pay R27.91 and households with an average income of R6501 and R13,000 per month were willing to pay R22.74 per month more than the households that earn above an average R13,000 per month.

5.3.4.2 The choice probabilities

Examination of the utility values indicated that the highest utility was experienced when the intervention option was to install shared facilities, followed by yard facilities and lastly communal facilities. The choice probabilities are an indication of how many times an alternative was chosen, based on the estimated model. As shown in Table 5-23, the model estimates that the communal facilities are chosen 18.9% of the cases; the shared facilities are chosen 54.6% of the cases; and the yard facilities are chosen 26.5% of the cases.

Table 5-23: Choice probabilities

Level of Service	Utility	Choice Probability (%)
Communal facilities (Status Quo)	0.60	18.9
Shared facilities (LOS 1)	2.07	54.6
Yard facilities (LOS 2)	1.17	26.5

A cross tabulation of the actual choices as recorded in the dataset against the choices predicted by the model is shown in Table 5-24. The rows represent the actual choice for the specified level of service. The columns represent the choice with the highest probability of being chosen, based on the choice model. The diagonal values represent the number of times that the model predicted a similar result with the actual choice that was made, e.g. the model correctly predicts the choice outcome for the status quo alternative 21% of the time (106 times out of 502); 35% of the time for the yard facilities alternative and 59% of the time for the shared alternative. Conversely, the off-diagonal values represent the number of times that the choice model incorrectly predicts an outcome (based on the attributes and socio-demographic characteristics of the respondent). For example, in cases where the status quo was the preferred option, the model predicts an outcome of shared facilities 53% of the time (268 times out of 502) and an outcome of yard facilities 25% of the time. As illustrated in the diagonal of Table 5-24, the model correctly predicts 46% of the actual observations (i.e. (106 + 891 + 253) / 2727). However, on the whole, the model predicts the preference for the status quo 514 times, compared to the actual choice of 502; predicts a preference for shared facilities 1490 times compared to 1516, which is the actual number of times the shared facilities was chosen and predicts that the yard facilities was chosen 722 times compared to the actual number of 708.

Table 5-24: Cross tabulation of actual vs. predicted choices

Description	Actual Choices	Predicted Choices		
		Status Quo	Shared Facilities	Yard Facilities
Status Quo	502	106(21%)	268(53%)	128(25%)
Shared Facilities	1516	284(19%)	891(59%)	341(22%)
Yard Facilities	708	124(18%)	331(47%)	253(36%)
Total	**2726**	**514**	**1490**	**722**

% values are subject to rounding error

As shown in Table 5-25, the respondents in Cape Town were willing to pay R32.06; R88.59; and R61.04 per month for the public health and environmental benefits of installing communal; shared and yard facilities respectively. The respondents' willingness to pay was highest when faced with the option to contribute towards improving an informal settlement located closest to their neighbourhood and would prefer to pay through their municipal bill. An additional willingness to pay of R27.91 and R22.72 per month was available among the respondents that earn between R3000 and R6500 per month and the respondents that earn between R6501 and R13,000 per month respectively.

Table 5-25: Willingness to pay estimates

Attribute	Willingness to Pay (UGX / month)		
	Communal facilities	Shared facilities	Yard facilities
Informal settlement located near the respondent's neighbourhood	23.72	23.72	23.72
Payment as part of municipal water bill	8.34	8.34	8.34
Health benefits	-	4.28	2.11
Environmental benefits	-	55.20	27.60
Total willingness to pay (R / household / month)	**32.06**	**88.59**	**61.04**
Total willingness to pay (2011 USD / household / month)	4.06	11.21	7.73

5.3.4.3 Measure of elasticity

The elasticity calculations measure the effects of changes in the quality of an attribute on the choice probabilities in the model. The direct and cross point elasticity for the attributes are presented in Table 5-26 and Table 5-27. All the elasticity estimates were between zero and one. As explained in Table 2-9, elasticity values between zero and one indicate relative inelasticity, i.e. increases in price of the alternative does not impact the probability of choosing that

alternative and will result in an increase in revenue. Conversely, reducing the price of the alternative will result in a reduction in revenue.

The direct point effect for increasing the cost of the shared facilities is -0.1. This means that a 1% increase in price will reduce the probability of selecting the shared facilities alternative by 0.1%. The cross point elasticity gives an indication of the attractiveness of the alternatives. It is expected that increasing the price of an alternative shall increase the attractiveness of the competing alternative.

The cross point elasticity estimates indicate the changes in probability of choosing yard facilities as a result of price changes of the shared facilities. The results show that a 1% increase in the price of shared facilities will result in a 0.207% increase in the probability of choosing the yard facilities.

At the branch level, the effect of increasing the price of shared facilities results in a 0.162% increase in the probability of choosing to retain the status quo; a 0.04% reduction in probability of selecting the yard facilities; and a 0.032% reduction in probability of selecting the shared facilities.

Table 5-26: Effect of price elasticity on preference for shared facilities (%)

Branch	Alternative	Branch	Choice	Total Effect
Branch=SQ	Communal Facilities	0.162	0.000	0.162
Branch=OTHER	*Shared facilities	-0.04	-0.100	-0.141
	Yard facilities	-0.032	0.207	0.174

* indicates direct elasticity effect of the attribute.

The changes in choice probabilities, resulting from changes in the price of yard facilities were also tested. The results show a value of -0.371 for the direct point effect. This implies that a 1% increase in price will reduce the probability of selecting the yard facilities by 0.371%. The cross point elasticity of the shared facilities indicates that a 1% increase in the price of shared facilities will result in a 0.18% increase in the probability of choosing the shared facilities.

Table 5-27: Effect of price elasticity on preference for yard facilities

Branch	Alternative	Branch	Choice	Total Effect
Branch=SQ	Communal Facilities	0.144	0.000	0.144
Branch=OTHER	Shared facilities	-0.028	0.180	0.152
	*Yard facilities	-0.045	-0.371	-0.416

* indicates direct elasticity effect of the attribute.

At the branch level, the effect of increasing the price of installing yard facilities results in a 0.144% increase in the probability of choosing to retain the status quo; a 0.028% reduction in probability of selecting yard facilities and a 0.045% reduction in probability of selecting shared facilities.

A simulation exercise was carried out to test the impact of changes in installation costs on the choice probabilities. Using the estimated model, the change in probability of making a choice was calculated using variations in the cost of a level of service option. The following changes in costs were tested: a 50% decrease in price; a 20% decrease in price; a 20% increase; a 50% increase and a 100% increase in the installation cost of the level of service.

The results for the preference for shared facilities re-iterate the findings of the elasticity calculations. As shown in Figure 5-17, there is a minimal change in choice probabilities (between 0% to 2% change in probability) when the cost of the shared facilities are varied between -50% to +100%. This means that changing the cost of the alternative does not significantly change the demand or preference for the shared facilities alternative.

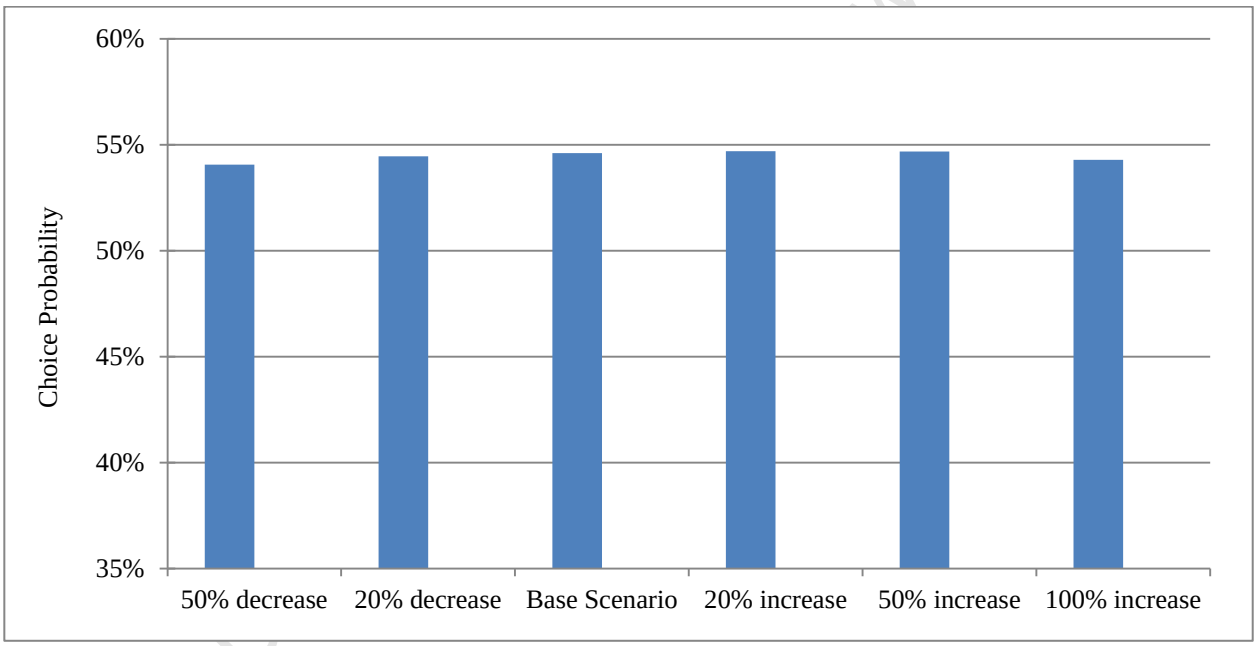

Figure 5-17: Change in choice probabilities for shared facilities

The simulation exercise for the yard alternative revealed that the preference for yard facilities was sensitive to changes in cost. As shown in Figure 5-18, increasing the cost of installing yard facilities by 20%, 50% and 100% would result in a 5%, 13% and 25% reduction in choice probability.

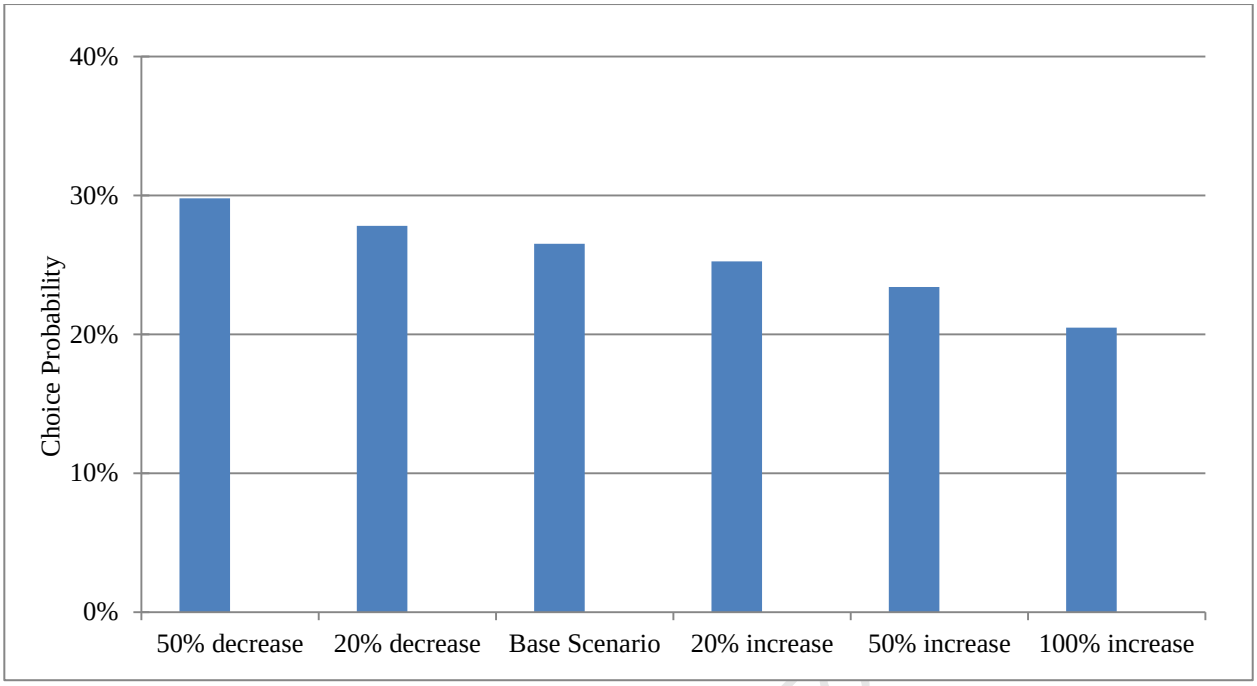

Figure 5-18: Change in choice probabilities for yard facilities

Figure 5-19 shows the effect of price changes on the probability of choosing to retain the status quo. Similar to the findings of the changes in cost for shared facilities, the choice probabilities resulting for varying the cost of communal facilities did not change significantly. The simulations showed that the preference for the communal facilities alternative change between -2% to 1% when the cost of communal facilities is varied between -50% to +100%.

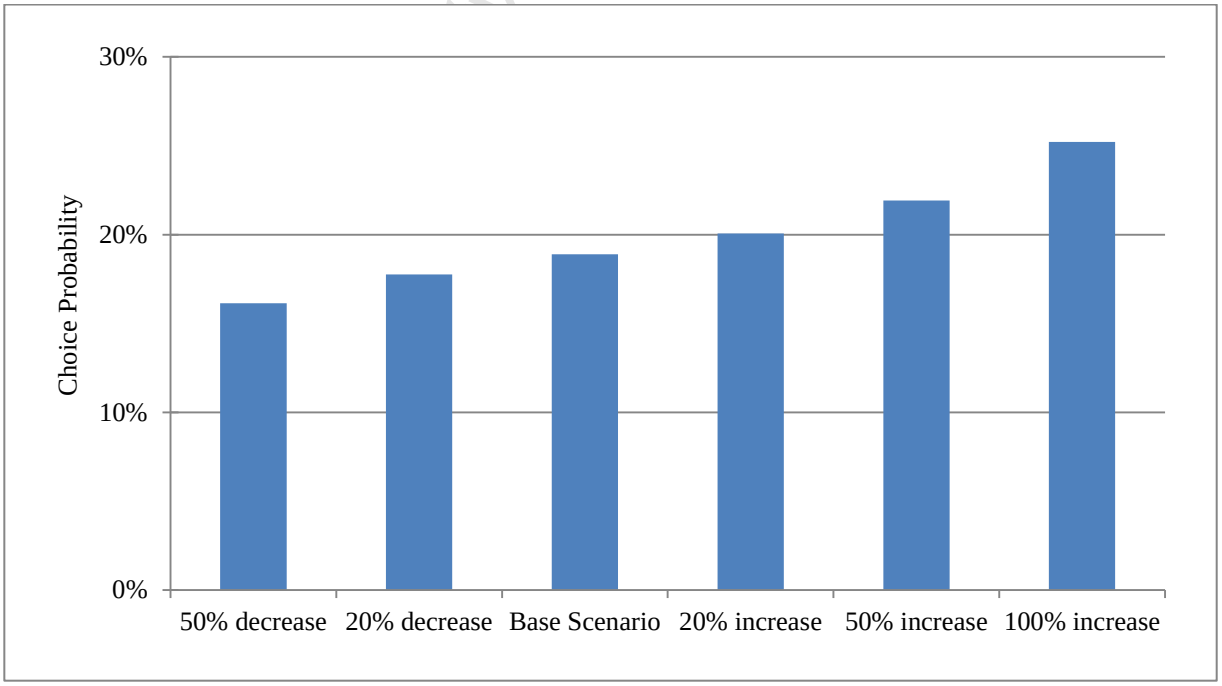

Figure 5-19: Change in choice probabilities for the status quo

5.4 The value of non-user benefits in Cape Town

The results of the nested model were analysed further to assess the potential impact of the willingness to pay estimates on planning level of service improvements. When the respondents in Cape Town were asked to pay towards improving levels of service in informal settlements, the model showed that 18.9% of the population chose to pay towards installing communal taps and toilets; 54.6% chose to pay towards installing a tap per household and a flush toilet shared between five households; and 26.5% chose to pay towards installing a yard tap and toilet.

When the informal settlement is located near the respondent's household and when the payment mode is the municipal water bill, the respondents were willing to pay R33.06 per household per month; R88.59 per household per month; and R61.04 per household per month for communal; shared; and yard facilities respectively (Table 5-28).

Table 5-28: Willingness to pay estimates for Cape Town

Level of Service	WTP Estimate (R / household / month)	WTP (2011 USD / household / month)
Communal Facilities	33.06	4.06
Shared Facilities	88.59	11.21
Yard Facilities	61.04	7.73

1 USD = R7.9 (Standard Bank, 2011)

5.4.1 Application of value estimates in investment decisions

Similar to the case of Kampala, the potential impact of the findings of the study were investigated by comparing the willingness to pay estimates against the city's plans for improving levels of service.

5.4.1.1 Comparison of investment costs and potential revenue

Based on CoCT (2008), 20% of households lack basic water and 57.7% lack adequate sanitation. Basic water is defined as communal standpipes within 200 m walking distance, while adequate sanitation refers to a communal or container toilet. The strategy of the city is to provide an emergency level of service (i.e. Service Level 0 in Table 5.1) to the households without any service, followed by an upgrade to a basic level of service. The city estimates that R4 million a month is required to cover the backlog in water and sanitation (CoCT, 2009). The plans to upgrade informal settlements to a higher level of service (in-house taps and flush toilets) are entrenched in the Housing Development Program, which is estimated to require a total of R236 million (29.9 million, 2011 USD) between 2009 and 2014. There is however a budget deficit (with respect to meeting the housing backlog) estimated at 51% of the amount required (CoCT, 2008:19). Given these challenges, the city may have to re-think its plan to

"jump" the water ladder (from basic to full level of service), and consider intermediate levels of service in the interim. Moreover, research has shown that bringing services closer to households would provide an incentive to improve housing conditions, and produce multiplier benefits that improve quality of life (Parikh, 2008). In light of this, three levels of service improvement options were tested:

- Installation of communal water taps to 23,377 households and container toilets to the 67,441 households that are currently served by emergency levels of service. An estimated R680,000 (a month is required to provide this level of service (Table 5-29).
- Installation of standpipes and flush toilets, to be shared between 20 households and 5 households respectively; to be provided to the 116,883 households in informal settlements. An estimated R7.8 million a month is required to provide this level of service.
- Installation of a tap and flush toilet in the yard of each of the 116,883 households in the informal settlements and 150,000 households in backyard shacks. An estimated R31.7 million a month is required to provide this level of service.

Table 5-29: Investment requirements for Cape Town

	Communal Facilities	Shared Facilities	Yard Facilities
Benefiting population (No. of households)	67,441	116,883	266,883
Annualised Cost per facility (R / household /year)	121	805	1,426
Total CapitaLand O&M Costs (R /year)	8,000,000	94,000,000	381,000,000
Total Monthly Cost (R / month)	680,035	7,840,901	31,714,596
Total Monthly Cost (USD / month)	86,000	992,500	4,000,000

The estimated paying population of 469,045 households was defined as the number of households that do not live in informal settlements and whose monthly household income is above R3000. The willingness to pay estimates shown in Table 5-28 were aggregated across the population to determine the expected revenue from non-user value. The results indicate an estimated monthly revenue potential of R21.8 million for communal facilities; R45.6 million for shared facilities; and R34 million for yard facilities.

Table 5-30: Potential revenue from non-user value in Cape Town

Level of Service	Willingness to pay (R / household / month)	Total willingness to pay (R / month)	Total willingness to pay (2011 USD / month)
Communal facilities	33.06	15,036,075	1,903,301
Shared facilities	88.59	41,550,725	5,259,585
Yard facilities	61.04	28,630,326	3,624,092

Table 5-31 shows the comparison between the investment requirements (Table 5-29) with the potential revenue from non-user benefits (Table 4-23). As shown in the Table 5-31, for the communal and shared facilities, the potential revenue from the non-user benefits exceeds the costs of providing the services. The non-user value results in potential revenue that exceeds the capital and O&M cost of communal facilities by 22.11 and of shared facilities by 5.30. This means that the municipality could potentially finance the required level of service improvements by using revenue collected from the residents of the city that do not live in informal settlements.

For the yard facilities, the benefit cost ratio of 0.90 means that the municipality cannot meet the investment requirements using revenue from non-user benefits alone and would have to find an alternative source of revenue to meet the 10% investment budget deficit. This finding makes the case for the adoption of an incremental approach to upgrading levels of service, involving installation of shared facilities which can be fully financed using non-user value.

Table 5-31: Comparison of investment cost and revenue from non-user benefits

Level of Service	Investment cost (R / month)	Total willingness to pay (R / month)	Benefit-cost ratio
Communal Facilities	680,035	15,036,075	22.11
Shared Facilities	7,840,901	41,550,725	5.30
Yard Facilities	31,714,597	28,630,326	0.90

5.4.1.2 Non-user value as a component of total economic value

Similar to the case of Kampala, the non-user values quantified in this chapter were described as a component of the total economic value of urban water services and validated against the findings of valuation studies in the transportation and environmental fields.

As explained in Chapter 2, the total economic value is the sum of use and non-use value. The average household water bill of R270 per month was adopted as proxy for user value, implying that the non-user value is 11%; 25%; and 18% of total economic value for the installation of communal, shared, and yard facilities respectively (Table 5-32). The ratio of use to non-use value was found to be 8.17; 3.05; and 4.42 for communal; shared; and yard facilities respectively. These findings are lower than the findings in Larson &Loomis (1993) where the non-user value was found to be 28% of the TEV of improving water quality; in Bristow *et al.* (1991) where non-user value was found to range between 39% to 50% of the TEV of public transportation. The ratio of use to non-user value is however comparable with Brown (1993) where the ratio of use to non-use value was found to range between 0.11 to 10.47; and with Sanders *et al*. (1990) where a ratio of 4 was found for the use to non-use value of preserving scenic revivers in Colorado.

Table 5-32: Non-user value as a component of total economic value

Level of Service	Willingness to pay (R / month)	Proportion of total economic value	Use : non-use ratio
Communal Facilities	33.06	11%	8.17
Shared Facilities	88.59	25%	3.05
Yard Facilities	61.04	18%	4.42

Similar to the case of Kampala, a benefit cost analysis was carried out to investigate the potential of non-user value to influence the outcome of investment appraisals. Due to difficulties in determining the monetary value of benefits such as changes in pollution gains in school attendance, this study only included the economic benefits described below. The inputs and assumptions made are shown in Table 5-33.

i. Direct economic benefits of avoiding diarrhoeal disease, i.e. financial savings from reduced treatment of diarrhoeal illness.

ii. Indirect economic benefits related to health improvements, i.e. health agency savings on diarrhoeal treatment.

iii. Non-health benefits related to water and sanitation improvements, i.e. the productive days gained by reduced illness or time taken away from work to take care of a minor.

Table 5-33: Inputs to calculation of economic benefits

	Value	Reference
Incidence rates (% households)	364 / 1000 people for communal facilities 284 / 1000 people for yard facilities	DWAF (2001)
% of incidences that seek treatment at health agencies	1% to hospitals at R1750 14% at clinics at R64.2	DWAF (2001)
Average no. of hospital days	3	DWAF (2001)
Average cost of treatment	R35	
Wage rate	R 120 per day	

Table 5-34 shows the comparison of costs and societal benefits. The benefit cost ratios that were based on calculation of the savings in health centre and patient costs, value of time savings and value of non-user benefits is 23.35 for the communal facilities; 5.40 for shared facilities; and 0.93 for yard facilities. The high benefit cost ratio for communal facilities is because there are few people that use emergency services and require to be upgraded to communal facilities (therefore low investments are required to provide this level of service).

Table 5-34: Comparison of costs and benefits of level of service interventions

	Communal Facilities	Shared Facilities	Yard Facilities
Calculation of Costs			
Number of beneficiaries	67,441	116,883	266,883
Annual installation costs per facility (R / year)	121	805	1,426
Tot. Annual installation costs (R / year)	8,160,420	94,090,815	380,575,158
Calculation of benefits			
Diarrhoeal incidences (No. /1000 people / year)	364	324	284
Total incidence (No. / year)	24,549	37,870	75,795
14 % that will seek treatment at clinics	3,437	5,302	10,611
Treatment costs at clinic (R / year)	220,644	340,376	681,243
1 % that will seek treatment at hospitals	245	379	758
Treatment costs at hospitals (R / year)	1,288,807	1,988,180	3,979,226
Health system costs saved (R / year)	1,509,451	2,328,556	4,660,469
Patient costs saved (85% self-medicate) (R / year)	625,992	965,687	1 932,767
Value of time saved from reduced illnesses (R / year)	7,990,776	6,611,454	5,232,132
Value to society (per paying households) (R / household / month)	32.06	88.59	61.04
Total value to society (paying households=496000) (R / year)	180,432,903	498,608,697	343,563,916
Total Annual benefits (R / year)	190,559,121	508,514,395	355,389,283
Benefit cost ratio	23.35	5.40	0.93
Annual cost per non-user beneficiary	17	201	811

These findings suggest that the value of non-user benefits has the potential to improve the outcome of investment appraisals. The benefit cost ratios for the options to install communal and shared facilities indicate that there is a net positive societal benefit resulting from the health system costs saved, the patient costs saved, the value of time savings and the value of the non-user benefits. For the option to install communal facilities and share facilities, the total revenue from the non-user value exceeded the cost of providing the services, suggesting that the municipality could potentially finance its upgrade programmes by harnessing the non-user value among the non-poor members of the society. However, for the option to install yard facilities, the cost of providing the services exceeded the total societal benefits. It should however be noted that only direct economic costs were included in the benefit cost analysis, and inclusion of such benefits as the environmental benefits associated with improved levels of service, socio-economic costs associated with improved school attendance could increase the total societal benefits. Furthermore, the non-user value applied in the cost benefit analysis is a

conservative estimate. As explained in section 5.3.4.1, there is an additional willingness to pay among the middle income residents of the city.

Similar to the findings in Kampala, the non-user value for the three level of service options constituted over 90% of the total societal benefits of improving services. The results also show that the annual cost to the non-poor household was R17; R201; and R811 for installation of communal; shared; and yard facilities respectively.

5.4.1.3 Non-user value as a portion of household expenditure on water services

In order to test for affordability, the non-user value was compared to the average household income. Based on a weighted average income of R11,000 per household per month, and an average household water bill of R270 per month, the additional expenditure on non-user benefits would increase the monthly household water bill to about 3% of the household income. These findings are well within the 5% level that has been adopted by development agencies and scholars for appraisal of water projects.

5.5 Summary of findings

The study found that the non-user value of improving the levels of water and sanitation services in informal settlements in Cape Town is R33.06 (2011 USD, 4.06); R88.59 (2011 USD, 11.21); and R61.04 (2011 USD, 7.73) per household per month for installation of communal, shared, and yard facilities respectively. The willingness to pay was highest when the informal settlement was located near the respondent's household and when the payment mode was the municipal water bill.

The significant components of non-user value were found to be the health benefits associated with reduced diarrhoeal infection among the poor and the environmental benefits associated with reduced pollution in the rivers and streams. The respondents were willing to pay R4.28 (2011 USD, 0.54) per month for the reduction in diarrhoeal incidences associated with shared facilities and R2.11 (2011 USD, 0.27) per month for the reduction in diarrhoeal incidences associated with yard facilities. The willingness to pay for the environmental benefit was R55.20 (2011 USD, 6.99) per month for shared facilities and R27.60 (2011 USD, 3.49) per month.

The socio-demographic groups that expressed higher willingness to pay for improving services were females; the employed; respondents that are educated to matric level and above; and larger households. An additional willingness to pay of R27.91 (2011 USD, 3.53) and R22.74 (2011 USD, 2.88) per month could potentially be paid by the respondents that earn between R3000 and R6500 per month and the respondents that earn between R6501 and R13,000 per month respectively.

In order to investigate the potential influence of the willingness to pay estimates on the outcome of investment appraisals, the potential revenue from non-user value was compared to the cost of installation of three level of service options. The study found that the potential revenue from the non-user benefits exceeded the cost of installing the communal and shared facilities by 22.01 for communal facilities and by 5.30 for shared facilities. This means that the municipality could potentially finance the installation of communal and shared facilities by harnessing the non-user value from the non-poor residents of the city. The revenue for the installation of yard facilities was however lower than the costs, implying that the municipality cannot meet the investment budget for installing yard facilities using the non-user value alone, and would have to find alternative financing to meet the full investment budget.

The study also computed the societal benefits of improving levels of service and found that the net societal benefits form improving levels of service were positive, with benefit cost ratios of 23.35; 5.4; and 0.93 for communal; shared and yard facilities. The non-user benefits constituted over 90% of the total societal benefits of improving the levels of services.

The study found that the additional expenditure on non-user benefits would increase the monthly household water bill to about 3% of the household income. Based on the value typology described in Chapter 2, and on the assumption of an average user value of R270, the proportion of non-user value of improving water and sanitation in informal settlements in Cape Town was 11%; 25%; and 18% of total economic value for the installation of communal, shared, and yard facilities respectively.

Similar to the case in Kampala, the elasticity calculations indicated that the preference for communal and shared facilities was not sensitive to price changes. The option to install yard facilities was however sensitive to price changes, it is likely that the preference for yard facilities will decrease if prices were increased.

The primary objective of this research was to investigate the potential of non-user value in increasing the resource pool for financing of water services. The findings of this study suggest that there is a willingness among the non-poor members of the City of Cape Town, to pay for improving the levels of water and sanitation services in informal settlements. The willingness to pay is influenced by the location of the informal settlement to be upgraded, the mode of payment, the expected environmental benefits, and the expected health benefits from improving the water and sanitation services. Three level of service improvement options were tested: the option to install communal facilities; shared facilities; and yard facilities. For the alternatives to install communal and shared facilities, the potential revenue from the non-user value was higher than the capital and operational cost of the services. This implies that there are net positive benefits, and municipalities could harness these benefits for the purpose of financing level of service upgrades in informal settlements. However, for the alternative to install yard facilities, the potential revenue from the non-user value constituted 90% of the cost of the services, implying that the municipality would have to find alternative revenue to provide yard facilities to informal settlements.

6. Policy implications

As identified in the literature review, some of the challenges facing the improvement of services to informal settlements are:

i. Inadequacy of the current financing mechanisms to incorporate the value perspectives of the beneficiaries, resulting in consistent under-pricing of water and sanitation services.

ii. Technical and institutional difficulties associated with choice of appropriate and acceptable level of service options in informal settlements.

This chapter synthesizes the quantitative results of the studies in Kampala and Cape Town, with the aim of informing policy and practice of economic efficiency, with respect to choice of levels of service and willingness among society to pay for interventions in informal settlements. The key policy questions discussed in this chapter are:

i. Can the non-user benefits of improving levels of service in informal settlements be identified? How do the different levels of service compare?

ii. Who receives the benefits of improving services to informal settlements? Who pays for the improvements and what are they willing to pay?

iii. What is the impact of non-user value on the investment indicators commonly used in appraisals?

6.1 Introduction

In order to make decisions, policy makers are required to assess the impact of different policy options on the population, on government, and possible interaction with other policies and other stakeholders in the society. In the water sector, the assessments involve an analysis of the cost of poor water services, the cost of interventions and the potential impacts of the interventions.

As discussed in the preceding chapters, the criteria for the intervention options depends on *inter alia*, cost, technical feasibility, affordability and the expected economic and health benefits. This thesis has investigated the costs and benefits of three level of service interventions as described below:

i. Communal facilities involving the provision of a tap (shared between 20 households) and a dry toilet (shared between seven households).

ii. Shared facilities involving provision of a tap and a flush toilet shared between five households.

iii. Yard facilities involving provision of a tap and a flush toilet in the yard.

6.2 The value perspectives on improving levels of service in informal settlements

The difficulty in identifying and quantifying the benefits of improved water and sanitation has been identified as one of the challenges of valuation studies (Raucher *et al.*, 2005; Bosch *et al.,* 2001). In order to deconstruct the different value perspectives among residents of the city, the definition of total economic value was taken as the sum of user value and non-user value, as adopted from the transportation and environmental literature (Humphreys, 2003; Rogers *et al.*, 1998). Thus the benefits of the urban water system from the perspective of a user of the water services could be isolated from the benefits as felt by an individual who does not directly use the water service. The beneficiary population are defined as the residents of informal settlements, currently serviced by emergency or basic levels of water and sanitation. The paying population (the non-users) are defined as the "non-poor" residents of the city that do not live in informal settlements and have a household income above the low-income threshold. Through a survey of the residents of Kampala and Cape Town, the study developed a value typology that identifies the components of non-user value that are of significance to the population (Figure 6-1). The components of non-user value, as identified by the "non-poor" residents of Kampala and Cape Town, are described in the following sections.

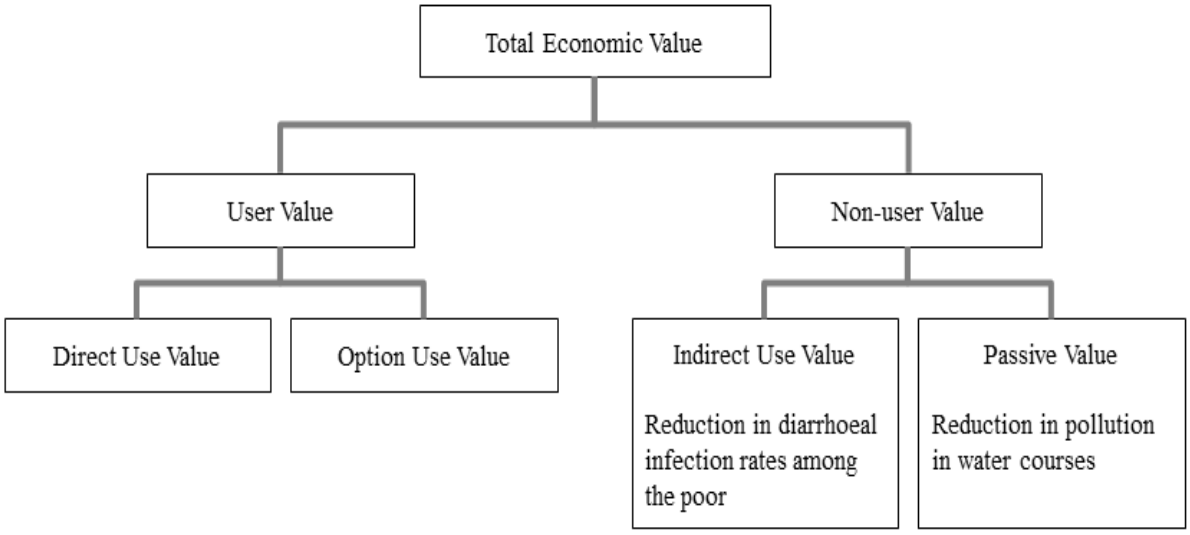

Figure 6-1: Typology of value for urban water services

6.2.1 Indirect use value

Indirect use value, associated with consumption of the service by others, can be described in two forms: vicarious and functional indirect use values.

6.2.1.1 Vicarious indirect use value

Vicarious indirect use value is associated with use by others who are known to the "non-user". The source of utility is linked to the relationship between the direct beneficiary and the non-user, e.g. use by relatives or friends that live in informal settlements. The initial surveys that aimed to identify variables to include in the choice experiment did not result in a high recognition of vicarious indirect use as a source of benefit. In the Cape Town case, this finding was not unexpected; it is plausible that there are few or no direct relationships between people that live in informal settlements and those living in suburban Cape Town. The social segregation policies that influenced urban planning in South Africa prior to the 1990s promoted construction of township areas (predominantly occupied by low income migrant workers) in locations far removed from the higher and middle income neighbourhoods. Following the lifting of the apartheid policies in 1990, the City of Cape Town has seen a rapid increase in rural-urban migration and with it, a rapid growth in informal settlements, usually on the fringes of the former townships, further exacerbating the inequalities in levels of living (CoCT, 2006). On the other hand, the low recognition of vicarious indirect benefits in the Kampala case was not expected. Unlike in Cape Town, informal settlements in Kampala are scattered around the city, and are thus more likely to have direct linkages with the middle and high income residential areas.

6.2.1.2 Functional indirect use value

Functional indirect use value is associated with utility derived as a result of use of the service by others who are not known to the "non-user", e.g. the health benefits resulting from a high coverage of safe water and sanitation in the city. In order to test this, the following variables were measured:

- Health benefits, described as the reduction in diarrhoeal infection rates as a result of level of service improvements.
- Socio-economic benefits, described through reduction in school days lost to children absent as a result of diarrhoeal disease.
- Economic benefits, described through the savings in tax money spent on treatment of diarrhoea that could otherwise be spent elsewhere.

Although the respondents in both Kampala and Cape Town recognised the presence of socio-economic and economic benefits of improving levels of service of the poor during the initial survey, when requested to trade off the costs of improved levels of services in the choice experiment, these benefits did not play a significant role in determining their choice of improvement option. The health benefits were however a significant component in their choice process. Functional indirect use value was thus identified *via* the health benefit of reducing diarrhoeal infection rates.

6.2.2 Passive use value

Passive use value relates to the desire to maintain a resource for use by future generations (bequest value), or the utility derived from the existence / availability of a resource (existence value). Initial interviews revealed that the desire to maintain a quality environment for future generations (bequest value) was ranked the most preferred benefit from a list that included improving aesthetic quality and reducing tax money spent on environmental clean-ups. Both cities have expressed concern over environmental pollution from informal settlements. Over 90% of the 9000 springs that are scattered around Kampala city are reported to be unfit for drinking water use (GoU, 2007; Chemiphar & HSC, 2006). Similarly, of 34 sites along Cape Town's rivers, only three were found to be fit for recreational and domestic use (River Health Programme, 2005). The passive use value is thus described as the reduction in pollution of water courses.

6.3 Valuation of non-user benefits: significance for benefit studies

It has been established that there are benefits that members of society receive when water and sanitation services in informal settlements are improved (OECD, 2011a). Such benefits, which cannot be measured through the conventional demand and supply approach, are valued using non-market valuation techniques such as stated preference methods. Choice models were used to estimate the value of the benefit categories identified in Section 6.2. The key model outputs are utility values, from which choice probabilities are derived; and parameter coefficients, from which willingness to pay estimates are derived.

This study shows that econometric analyses can be effectively used to value the non-user benefits of urban water services. The findings of the value analyses discussed in Chapter 4 and Chapter 5 were comparable to the findings in transportation and environmental research. The application of the stated preference technique in this study could provide municipalities with a valuation tool that is capable of generating more information than the commonly used methods such as the benefit transfer method and the contingent valuation method (Bateman *et al.*, 2002). Furthermore, the study collected empirical data at a local scale, and identified influences which would normally be excluded, but which may be significant to a benefit study, e.g. the impact of the location of informal settlement on willingness to pay and the preferred mode of payment.

6.4 Valuation of non-user benefits: significance for strategic planning

The literature review revealed the need to strengthen institutional decision making and participatory processes in planning. The valuation of non-user benefits could increase the levels of community participation through collective decision making and identification of socially

acceptable choices. This section highlights the potential influence of the results of the two empirical studies on management and planning for service delivery.

6.4.1 The influence of attitudes and perceptions

The attitudes and perception sections of the survey, as presented in Chapter 4 and Chapter 5, were aimed at determining the opinions and relative importance of service delivery in informal settlements from the perspective of residents who receive full water and sanitation services and who earn above the low income threshold of the respective city. The respondents were requested to rate their perception of various municipal services, including improvement of services in informal settlements. The results show that the respondents feel that the city should place a high level of priority to improving water and sanitation services in informal settlements. However when compared with their attitudes to municipal services to their homes, service delivery to informal settlements ranked low on their priority list.

The Kampala response showed that on average, only about 35% of the respondents were either satisfied or very satisfied with service delivery to their homes. In contrast, 70% of the respondents felt that the city should place either very high or high priority on taking water and sanitation services closer to the dwellings in informal settlements. However when ranked against the level of priority placed on other services, the extension of services to informal settlements emerged 7th from the list of 11 possible priority areas.

On the other hand, the Cape Town responses show that there is a generally high level of satisfaction with service delivery to the respondents' homes: 91% of the non-poor respondents were either satisfied or very satisfied with municipal service delivery to their homes. The results show an almost equal number concerned about service delivery in informal settlements; 80% of the respondents felt that this should be given a high or very high priority from a list of possible priority areas such as improving response time to customer complaints and providing advance warning in event of interruption in supply. This ranking is quite similar in the case of Kampala where service delivery ranked 8th from a list of 12 possible priority areas. This has possible implications for valuation studies of marketing and financing campaigns done by the city. Respondents may be less inclined to respond positively or contribute to improving services in informal settlements if they are dissatisfied with the services to their own homes.

6.4.2 Formulation of pro-poor oriented strategies

One of the key recommendations from international policy discussions is that governments should encourage policy formulation based on customer-oriented service provision, with special consideration given to increasing accessibility to the sections of the population that cannot afford to pay for the services(WHO/UN-Water, 2012). There are also calls for ensuring financial sustainability through cost recovery from users. These potentially conflicting policy objectives may pose particular challenges to service providers, especially in cases where a large

section of the population are poor and thus unable to pay. In the case of water supply in Kampala, the challenges relate to funding backlogs in service provision to the estimated 40% of the population that live in informal settlements, and to choice of appropriate level of service among others. In Cape Town, the policies call for demand driven planning and recognition of the economic value of water. This study provides a solution to this conflict by: (i) assigning part of the financing responsibility to the portion of the population that can afford to pay; and (ii) applying a demand-driven approach to making decisions on the choice of technology and management of service.

The study tested the influence of distance and institutional trust on willingness to pay, and found that the respondents were generally willing to pay more towards improving informal settlements that were located nearer to their neighbourhoods. In Kampala, the willingness to pay also increased if the respondents were assured that their contribution would be dedicated to improving the informal settlement through ring fencing or creation of a dedicated fund. The willingness to pay was also higher among the lower educated (those who do not have tertiary education) and among the lower middle and high income respondents. When given the option to opt out of choosing a preferred improvement option, the socio demographic profiles that exhibited a positive willingness to pay were: the employed, the main income earners of the household, households that had members that were involved in social and environmental issues in the community, and the lowest income tier.

In Cape Town, willingness to pay was highest when the option was to pay through the municipal bill and when the informal settlement was located near the respondent's neighbourhood. Willingness to pay was also highest among females; the employed; groups educated to tertiary level and middle income respondents. The willingness to pay also increased with increasing household size. The study found that the price elasticity for the option to improve the level of service to shared facilities is relatively inelastic. That means that their preference for the shared alternative will not change if prices increased. However, the improvement to yard facilities was found to be price elastic. This means that the preference for the improvement to yard facilities will likely reduce if the price increased.

This information is valuable for strategic planning purposes as it provides insight into what the different segments of the population prefer and how much they are willing to pay for those preferences. This could be used to develop subsidies that are targeted better to meet the requirements of both the beneficiaries and the rate-payers.

6.5 Data collection and modelling

This section discusses some of the constraints and limitations that were faced during survey development through to the modelling of the data. Proposals for improvement and recommendations for future studies in this area are also discussed.

6.5.1 Experimental design

Based on the literature review and on *a priori* expectation, variables that were assumed to contribute to the total non-user value of water services were collected, and an initial survey carried out to narrow the list down so that only relevant attributes could be included in the SP survey. Due to data limitations, some of the values of these attributes could only be inferred from secondary data. For example, the reduction in the cost of treatment of diarrhoea was inferred from the same records from which the diarrhoeal infection rate was calculated. This resulted in high correlation between the attributes, and posed a challenge during the modelling process, e.g. the cost of diarrhoea and the school days lost due to diarrhoea were highly correlated to diarrhoeal infection rate and had to be excluded from the models. The potential for correlation could have been minimized by improving the statistical design of the experiment, either through an iterative process, or through a procedure that would result in an "optimal" design (involves minimizing the variances around the attributes) that could also have helped to ensure that only the variables that explain the respondents' preferences were used in the survey. Humphreys (2003) applied an iterative experimental design process and got satisfactory results. Based on preceding knowledge from previous studies, and with a simulated dataset, he was able to construct boundary values around which to base the experimental design. At the time of the experimental design, the researcher could not find similar studies and thus had no basis on which to construct boundary values and iterate the experimental design. This study now provides such information, on which further research in this area could anchor an experimental design.

6.5.2 Design of the stated preference questionnaire

Previous studies have expressed concern over the use of defined attribute levels and whether they adequately represent the limits of the trade-off that the respondents would be willing to make (Humphreys, 2003). The attempts to link school absenteeism among children living in informal settlements with willingness to pay did not result in a meaningful outcome. This could be attributed to correlation with other similar variables such as diarrhoeal infection rate. It could well be that respondents were not able to independently isolate the reduction in diarrhoeal infection variable from the reduction in absenteeism from school. It could also be that the description of the variable (reduction in school days among 1000 children)was too complex and was thus consistently ignored or that the difference between attribute levels was not significant enough to trade off (e.g. in the survey in Cape Town, the levels ranged from one to three days lost among 1000 children ever month).

The CV question was intended to validate the choice experiment by eliciting open-ended willingness to pay values. The framing of the questions (especially in the Kampala case study) did not result in any meaningful results; a high number of protest votes invalidated attempts at meaningful comparisons of outputs between the two elicitation formats. Open-ended questions have been known to result in either a high number of protest bids or unrealistically high WTP

amounts (Bateman *et al.,* 2002). Although the intention was to provide a simple elicitation of preference for levels of service and corresponding willingness to pay, it may be more meaningful to implement the validity tests through a split sample of respondents to the choice experiment and to a full CV questionnaire (Rolfe & Bennet, 2003; Sanders *et al.,* 1990).

The "free choice" question is usually constructed in such a manner as to facilitate the interpretation of the respondents' decision not to make a choice. For example the "free choice" question can be structured to infer a preference to retain the status-quo. The survey question in the Kampala study did not provide this anchor, and as a result could not generate adequate information for the interpretation of the respondents' choice to opt out. The questionnaire conducted in Cape Town provided this anchor by first presenting the current state of water and sanitation in informal settlements, followed by the choice pairs. Preferences for the "free choice" option were thus interpreted as a preference to do nothing, i.e. keep the status quo. Inclusion of the "free choice" option in a stated preference question is thought to provide a more realistic decision making environment than the forced choice scenario (Dhar & Simonson, 2003).

This study did not elicit the respondents' willingness to pay for their own use of water services. For comparative purposes, the use value was inferred through calculation of the average household municipal water bill. Direct measurement of use value as part of the study would have provided more information against which to anchor the results from the model and thus provide a more accurate basis for the proportions of non-use value to total economic value. It would also have enabled calculation of consumer surplus, the total amount that people would be willing to pay over and above the current water and sanitation municipal bills, and to isolate other components of use value (e.g. option value) if any.

6.5.3 Analysis of stated preference data.

The SP data was analysed using a basic MNL model for the Kampala data and a nested model for the Cape Town data. The Cape Town data showed a high percentage of non-trading; out of the 200 respondents with preference for the shared facilities, 168 consistently chose the option not to pay when given the opportunity. Similarly for the preference for yard facilities; 78 of the 103 respondents consistently took the option not to pay if they could. One of the assumptions of the MNL is that all responses are independent of each other (Hensher *et al.,* 2005). In reality however, and under the prevailing survey, the assumption of independence of responses may have been compromised. Although the total survey time was kept optimal (between 25 and 35 minutes), there may have been respondent fatigue, caused primarily by the complexity of the questionnaire. The respondents were requested to rate attitudes, choose a preference from a set of 8 or 9 choice pairs, answer contingent valuation questions, and then finally fill out demographic information. Studies have shown that respondents sometimes anchor their responses to either their previous answers or to a previous question, which could lead to choice probabilities that are not based on the respondents' preferences (Humphreys, 2003; Bradley &

Daly, 1993). Meyerhoff & Leibe (2006) found that the tendency to consistently choose the status quo increased when the experiment was considered complex (difficult to compare the alternatives); when there was a high level of protest (e.g. protests against increasing taxes in lieu of improved efficiency of public expenditure); or when there were attitudinal influences, e.g. with respect to perceptions and prioritisation of the resource under valuation. As summarised in Rolfe & Bennet (2003), the effect of the complexity of the choice experiment could be tested by conducting the experiment using split samples containing variations in the design parameters to facilitate the identification of inconsistencies in choices, or by relaxing some of the assumptions (e.g. the normal distribution of the error terms) of the MNL model. The nested model was applied as a solution to relaxing the independence of alternatives assumption, and although the results were satisfactory, there may be room to improve the data collection methods to minimise complications in data analysis.

In order to check for validity, the proportions of TEV as determined from the Kampala and the Cape Town models were compared with estimates from other SP studies; mostly from the transportation and environmental fields. As shown in Table 6-1, the findings of the Kampala study are comparable to the findings of previous studies. In the study in Cape Town, the respondents' expressed a higher preference for shared facilities, as evidenced by the choice probability of 54.6% compared to 18.9% probability for communal facilities and 26.5% probability for yard facilities. As a result, the proportions of total economic value for the communal and yard facilities were lower than the findings of previous studies.

Table 6-1: Comparison of non-use value measurements

Reference and location of study	Subject under Valuation	% of TEV
Larson & Loomis (1993)	Market behaviour among whale watchers	28%
Bristow *et al.* (1991) Leeds, UK	Public transportation	39% to 50%
Painter *et al.* (2002) USA	Rural transit	74%
Humphreys (2003) Edinburg, UK	Rail transport	40%
Loomis (1987) USA	Use and non-use value for Mono Lake in California.	52%
Sanders *et al.*. (1990) USA	Preserving fifteen wild and scenic rivers in Colorado.	35%
Whitehead & Groothuis (1992) USA	Water quality improvements in Tar-Pamlico River in North Carolina	84%
Current Study Kampala, Uganda	Improving levels of water and sanitation in informal settlements	54%, 48% and 57%
Current Study Cape Town, South Africa	Improving levels of and sanitation in informal settlements	11%; 25%; and 18%

6.6 Conclusions

This study found that the maximum value of non-user benefits of improving water and sanitation levels of service in informal settlements in Kampala is 16,528 UGX (2010 USD, 9.86); 13,063 UGX (2010 USD, 7.79); and 18,588 UGX (2010 USD, 11.09) per household per month, paid towards communal, shared and yard facilities. In Cape Town, the study found that the maximum value of non-user benefits of improving water and sanitation levels of service to be R33.06 (2011 USD, 4.06); R88.59 (2011 USD, 11.21); and R61.04 (2011 USD, 7.73)per household per month for communal facilities; shared facilities and yard facilities respectively. The significant components of non-use value were found to be bequest value associated with environmental benefits; and indirect use benefits associated with public health benefits.

The findings of this study make the case for inclusion of the non-use value in benefit studies, especially when the purpose is to improve water and sanitation levels of service of the poor in informal settlements. The non-user value can potentially contribute between 13% and 90% of the total benefits of improving levels of service, depending on the level of service to be implemented.

Researchers acknowledge a general lack of empirical data on which to base policy and management decisions (WHO, 2012). This study generates knowledge of people's perceptions on subsidy and the societal value for services to the areas of the city where poor residents cannot afford to pay. Estimates of willingness to pay and how it varies by location, by the level of institutional trust with respect to service delivery and by social-demographic characteristics suggest that there is substantial value among society that could be harnessed towards improving the levels of service of the sections of the city that are poorly served.

7. Conclusions of the study

This study identified and measured the non-user benefits of improving levels of water and sanitation services in informal settlements in Kampala and in Cape Town. The first section of this chapter summarises the concept of non-user value and its application in the development of the value typology that was applied in this thesis. The sections that follow summarise the findings of the surveys and data analyses, the lessons learnt during the course of the study and the proposals for future studies.

7.1 The non-user benefits of improving water and sanitation in informal settlements

The study adopted the definition of Total Economic Value as comprising the sum of user and non-user value (Pearce & Özdemiroglu 2002). The components of user value are:

- Direct use value, comprising benefits derived from consumptive use of the water resource, e.g. residential and agricultural water; and benefits derived from non-consumptive use, e.g. water for energy and recreation.
- Option use value, comprising benefits derived from maintaining the option to utilize the water service at a time in the future, e.g. water for fire demand.

The components of non-user value are:

- Indirect use value, comprising benefits derived from services provided for the consumptive use by others, e.g. services to the poor and to marginalized sections of the city; and benefits derived from having functional services in the city, e.g. tourist and industrial attractions from having well developed utility services.
- Passive use values, comprising benefits derived from the desire to maintain environmental integrity and from the desire to maintain quality water and sanitation services for future generations.

The study applied a stated preference survey to quantify the trade-offs that the non-poor respondents in the cities of Kampala and of Cape Town were willing to make for improvements in levels of water and sanitation service in informal settlements. The survey was designed to quantify the values that respondents attached to different attributes representing the components of non-user value associated with different levels of service options. The components of non-user value that were tested include: health benefits associated with reduction in diarrhoeal infection; the socio-economic benefits associated with reduction in school absenteeism due to diarrhoeal disease; the economic benefits associated with reduction

in health agency cost of treatment of diarrhoea; and environmental benefits associated with reduced pollution in water courses. The influence on the respondents' willingness to pay of the mode of payment and of the location of the informal settlement to be improved was also tested. A contingent valuation question was posed to provide validation of the stated preference findings. Information on the respondents' attitudes and perceptions of a range of municipal services was also collected to provide background information and to ground the respondents' value perspectives.

7.2 The value of the non-user benefits

The primary objective of this thesis was to investigate the potential of non-use value to increase the resource pool for financing water services, with emphasis on improving levels of service in informal settlements.

The study found that the maximum non-user value among the respondents of Kampala is 16,528 UGX (2010 USD, 9.86); 13,063 UGX (2010 USD, 7.79); and 18,588 UGX (2010 USD, 11.09) per household per month, paid towards communal, shared and yard facilities respectively when the informal settlement was located near the respondent's household and if the payment mode was through a fund dedicated for the intended purpose only. Taking an average water bill of 14,000 UGX per household per month as proxy for user value (NWSC, 2009), the non-use value amounts to 54%, 48% and 57% of the total economic value of communal, shared and yard facilities respectively.

The non-use value among the respondents in Cape Town is R33.06 (2011 USD, 4.06) per household per month for communal facilities; R88.59 (2011 USD, 11.21) per household per month for shared facilities; and R61.04 (2011 USD, 7.73) per household per month for yard facilities. The respondents' willingness to pay was higher when the informal settlement to be improved was located near the respondents' neighbourhood, and when the payment is made through the municipal bill. The non-use value amounts to 11%; 25%; and 18% of total economic value of communal, shared and yard facilities respectively. Other studies have found that the non-use value was 28% (Larson & Loomis, 1993); 40% (Humphreys, 2003); between 39% to 50% (Bristow *et al.* (1991) of the total economic value of a range of transportation and environmental resources.

7.2.1 Significance of the study findings

The current approach to policy and planning incorporates the requirements of the user only. In the case of water and sanitation services, where the costs and benefits of adequate levels of service are not felt by the user alone, there may be a case for incorporating the views of society as a whole, including non-users, in the planning process. In addition, researchers have made several calls to revise appraisal and valuation studies in order to incorporate externalities and societal objectives such as increasing access to the poor (Laird *et al.*, 2009:

Rogers *et al.,* 1998). One of the obstacles for inclusion of these benefit categories is the difficulty in identifying and quantifying the components of value. This study has quantified the components of non-user value and how they vary with location, payment mode and demographic characteristics of the "non-user". Incorporation of this information in a valuation study would enable a demand-driven investment analysis and provide a more informed trade-off between the requirements of the users (in this case the poor) and the ability and willingness of the non-users to pay for the proposed improvements. It would also improve transparency and accountability in municipal decision-making.

7.2.2 Recommendations for future studies

This section discusses some of the challenges faced during the study, and provides some indications for future studies drawing on literature and on the experience gained from this study.

This study measured the effect of distance (location of the informal settlement to be improved relative to the respondents' household) as a contributing factor to non-user value. In both case studies the location of the beneficiary informal settlement was a significant portion of the respondents' willingness to pay. It may be of future interest to know where the distance limit lies in the respondents' decision process. This information could be of use in the definition of responsibilities between stakeholders and could enrich discussions relating to catchment management of water service areas and decentralisation of management of municipal services.

In informal settlements with high population and housing densities, poor construction material, unsuitable geotechnical conditions, the impact of poor drainage is felt more adversely than in formal and planned neighbourhoods. The integrated urban water management approach advocates for the management of stormwater as an integral part of the urban water cycle. Future research could look into valuation of the benefits of improved stormwater management in informal settlements, and whether members of society are willing to pay for the benefits.

The study applied multinomial and nested logit models to explain the respondents' data. In order to validate the model outputs, the estimates from the choice experiment were compared with responses from a contingent valuation question. The model estimates were also compared with estimates from SP studies in the transportation and environmental fields. In order to improve validity testing, future research could go into standardising the questionnaire format developed in this thesis to maximise the information derived from the choice experiment and from the CV question.

7.3 Final comments

The increasing population growth among the low income residents of Africa cities means that municipalities have to increase the rate of infrastructure development, especially to informal settlements, where most of the low income population live and will live. High levels of poverty in informal settlements means that municipalities cannot look to user charges as the only revenue generation channel. This research was driven by the need to find an avenue of supplementing municipal revenue, specifically for the purpose of improving water and sanitation in informal settlements. The first part of the literature review looked at different justifications for a different approach to service delivery in informal settlements. Firstly, attempts to improve operational efficiencies and expand services in the past have not produced the intended results, especially with respect to increasing coverage among the poor. Secondly, there are institutional and technological constraints that require special consideration for effective service delivery in informal settlements.

The thesis assumed the hypothesis that the "non-poor" members of society also stand to benefit when informal settlements are improved, and that these benefits could be converted into additional income that could improve the outcome of investment appraisals. The first issue that emerged was to identify which of these benefits are recognized among the "non-poor" population, and which ones could be adequately quantified. A key finding of the valuation exercise was that the "non-poor" population recognise and are willing to pay for environmental and public health benefits of improving levels of service in informal settlements. The valuation exercise also revealed that given certain conditions such as choice of location of the informal settlement to be improved and choice of mechanism through which their payment is collected, their willingness to pay could increase further.

In the city of Kampala, the significant component of non-user value was found to be the indirect use value associated with the health benefits of reducing diarrhoeal disease. The study found that the respondents were willing to pay up to 16,528 UGX (2010 USD, 9.86); 13,063 UGX (2010 USD, 7.79); and 18,588 UGX (2010 USD, 11.09) per household per month towards installing communal, shared and yard facilities respectively. On comparing the costs with the value of non-user benefits, the study found that the benefit cost ratios for improving the levels of service were 2.91 for communal facilities; 1.41 for shared facilities; and 1.13 for yard facilities. On comparing the non-user and user value, the non-user benefits were found to contribute approximately 54%; 48%; and 57% of the total economic value of installing communal, shared and yard facilities respectively.

In the City of Cape Town, the significant components of non-user value were found to be the indirect use value associated with the health benefits of reducing diarrhoeal disease and the passive use value associated with environmental benefits of reduced pollution of water courses. The study found that the respondents were willing to pay up to R33.06 (2011 USD, 4.06); R88.59 (2011 USD, 11.21); and R61.04 (2011 USD, 7.73) per household per month for installing communal, shared, and yard facilities respectively. On comparing the costs with the value of non-user benefits, the study found that the benefit cost ratios were 22.11 for communal

facilities and 5.30 for shared facilities. The revenue for the installation of yard facilities was however lower than the costs. The benefit cost ratio of 0.90 for yard facilities implies that the municipality cannot meet the full investment budget for installing yard facilities using the non-user value alone, and would have to find alternative financing to meet the budget deficit.

This thesis has shown that stated preference methods can be a useful tool to collect information, to test responses to changes in policy, and to enhance stakeholder participation in planning informal settlement upgrade projects. The findings of this thesis provide evidence that municipal governments could increase their revenue by applying the willingness of the residents in fully serviced households to pay for improving levels of water and sanitation services to households in informal settlements.

Reference list

Adamowicz, W., Louviere, J. & Williams, M. 1994, "Combining Revealed and Stated Preference Methods for Valuing Environmental Amenities", *Journal of Environmental Economics and Management*, vol. 26, no. 3, pp. 271-292.

Agenda 21 1992, "The Rio Declaration on Environment and Development", *United Nations Conference on Environment and Development* Rio de Janeiro, Brazil, 3 to 14 June 1992.

Aldred, J. 1994, "Existence Value, Welfare and Altruism", *Environmental values*, vol. 3, pp. 381-402.

Alence, R. 2002, "Sources of Successful Cost Recovery for Water: Evidence from a national survey of South African municipalities", *Development Southern Africa*, vol. 19, no. 5, pp. 699-717.

Al-Ghuraiz, Y. & Enshassi, A. 2005, "Ability and willingness to pay for water supply service in the Gaza Strip", *Building and Environment*, vol. 40, no. 8, pp. 1093-1102.

Allan, K. & Heese, K. 2009, 23 July 2009-last update, *Service Delivery Protests Set to Peak in 2009* [Homepage of Municipal IQ], [Online]. Available: http://www.municipaliq.co.za/press.php [2009, 30 July 2009].

ANC 1994, *The Reconstruction and Development Programme.* , Umyango Publications., Johannesburg.

Anderson, E. 1993, *Value in Ethics and Economics*, Harvard University Press, Cambridge, Mass.

Anti-Privatisation Forum. 2008, 8 May 2008-last update, *Johannesburg Water defies court ruling on prepaid water meters* [Homepage of Anti Privatisation Forum], [Online]. Available: http://apf.org.za/breve.php3?id_breve=14 [2009, Feb/06].

Aqua Consult. 2003, *Identification of Management Options for Improved Water and Sanitation Services in Informal Settlements in Kampala: management principles and options*, NWSC and WSP-Africa.

Arrow, K., Solow, R., Portney, P., R., Leamer, E., E., Radner, R. & Schuman, H. 2001, *Report of the NOAA Panel on Contingent Valuation*.

Bateman, I.J., Carson, R.T., Day, B., Hanemann. W, M., Hanley, N., Tanis Hett, T., Lee, M., Jones., Loomes, G., Mourato, S., Özdemiroglu, E. & Pearce, D.W. 2002, *Economic Valuation With Stated Preference Techniques: A Manual*, Edward Elgar.

Bateman, I., J. & Langford, I., H. 1997, "Non-user's Willingness to Pay for a National Park: An Application and Critique of the Contingent Valuation Method", *Regional Studies*, vol. 31, no. 6, pp. 571-582.

Bateman, I., J., Langford, I., H. & Nishikawa, N. 1999, *The Aggregation of Non-User Benefits: A Case Study Illustrating Different Approaches*, GSERGE Working Paper GEC 99-18 edn, Economic and Social Research Council.

Berg, S., V. & Mugisha, S. 2009, " Pro-poor water service strategies in developing countries: Promoting justice in Uganda's urban project".

Birol, E., Karousakis, K. & Koundouri, P. 2006, "Using economic valuation techniques to inform water resources management: A survey and critical appraisal of available techniques and an application", *Science of The Total Environment*, vol. 365, no. 1–3, pp. 105-122.

Blamey, R.K., Bennett, J.W., Louviere, J.J., Morrison, M.D. & Rolfe, J. 2000, "A test of policy labels in environmental choice modelling studies", *Ecological Economics*, vol. 32, no. 2, pp. 269-286.

Blamey, R., Gordon, J. & Chapman, R. 1999, "Choice Modelling: Assessing the Environmental Values of Water Supply Options", *Australian Journal of Agricultural and Resource Economics*, vol. 43, no. 3, pp. 337-357.

Bliemer, M.C.J., Rose, J.M. & Hensher, D.A. 2009, "Efficient stated choice experiments for estimating nested logit models", *Transportation Research Part B: Methodological*, vol. 43, no. 1, pp. 19-35.

Bloom, D.E. & Canning, D. 2000, "The Health and Wealth of Nations", *Science*, vol. 287, no. 5456, pp. 1207-1209.

Bond, P. & Dugard, J. 2008, "Water, Human Rights and Social Conflict: South African Experiences", *Law, Social Justice and Global Development*, [Online], no. 1, pp. 10 October 2008. Available from: http://www.go.warwick.ac.uk/elj/2008_1/bond_dugard.

Bosch, C., Hommann, K., Rubio, G.M., Sadoff, C. & Travers. 2001, *Water, Sanitation and Poverty. (A Draft for Comment)*, World Bank.

BoU. , *Interbank Average Exchange Rates: Exchange rates for December 31, 2010* [Homepage of Bank of Uganda], [Online]. Available: http://www.bou.or.ug/bou/collateral/interbank_forms/2010/Dec/Major_31Dec10.html [2012, August, 12].

Bowers, J. & Young, M. 2000, *Valuing Externalities: A Methodology for urban Water Use*, CSIRO Urban Water program, Australia.

Brazell, JD., Diener, CG., Karniouchina, E., Moore, WL., Severin, V. & Uldry, P. 2006, "The Free Choice option and dual response designs", *Market Lett*, vol. 17, pp. 255--268.

Bristow, A.L., Hopkinson, P.G., Nash, C.A. & Wardman, M.R. 1991, "Evaluation of Use and Non-Use Benefits of Public Transport: Report Number 1 -Development of a Survey Methodology", *Institute of Transport Studies, University of Leeds*, vol. working Paper 309.

Brook, P. & Smith, W. 2001, *Improving Access to Infrastructure Services by the Poor: Institutional and Policy Responses*, World Bank.

Brown, T.C. 1993, "Measuring nonuse value: A comparison of recent contingent valuation studies", *W-133 Sixth Interim Report, Dep. of Agriculture and Applied Economics, Univ. of Ga. Athens*.

Buckingham, A. & Saunders, P. 2004, *The Survey methods Workbook: From Design to Analysis*, Polity Press, Cambridge, UK.

Cardone, R. & Fonseca, C. 2003, *Financing and Cost Recovery*, IRC International Water and Sanitation Centre, Delft, The Netherlands.

Carson, R., T., Flores, N., E. & Mitchell, R., C. 1999, "The Theory and Measurement of Passive-Use Value" in *valuing Environmental Preferences*, eds. I. Bateman J. & K. Willis G., at edn, Oxford University Press, Oxford, UK, pp. 97-130.

Casey, J.F., Kahn, J.R. & Rivas, A. 2006, "Willingness to pay for improved water service in Manaus, Amazonas, Brazil", *Ecological Economics*, vol. 58, no. 2, pp. 365-372.

Champ, P., A., Bishop, R., C., Brown, T., C. & McCollum, D., W. 1997, "Using Donation Mechanisms to Value NonUse Benefits from Public Goods", *Journal of Environmental Economics and Management*, no. 33, pp. 151-162.

Chemiphar and HSC. 2006, *Surveillance of Spring Water Sources within Kampala District: Kampala Urban Sanitation Project*, Kampala City Council, Kampala, Uganda.

Choe, K., Whittington, D. & Lauria, D.T. 1996, "The Economic Benefits of Surface Water Quality Improvements in Developing Countries: A Case Study of Davao, Philippines", *Land Economics*, vol. 72, no. 4, pp. 519-537.

CoCT 2010, *City of Cape Town 2010/2011 Medium Term Revenue and Expenditure Framework: Budget for the Financial Period 2010/11 - 2012/13*, City of Cape Town.

CoCT 2009, *Water Services Development Plan for City of Cape Town 2010/11 - 2013/14 : Final Report*, City of Cape Town.

CoCT. 2008a, *General Household Survey Analysis, 2006*, Strategic Development Information and GIS Department, Cape Town.

CoCT. 2008d, *Water and Sanitation Service Standard: Preliminary Draft*, City of Cape Town.

CoCT. 2008c, *Strategic Development Information and GIS Department, Characteristics of Households Living in Poverty*, City of Cape Town.

CoCT. 2008b, *Community Survey Analysis for Cape Town, 2007*, Strategic Development Information and GIS Department, Cape Town.

CoCT. 2007, *Water Services Development Plan for City of Cape Town 2007/08 - 2011/12*, CES, Stellenbosch.

CoCT. 2006, "Information and Knowledge Management Department, The Spatial Distribution of Socio-Economic Status, Service Levels and Levels of Living in the City of Cape Town 2001".

Constitutional Court of South Africa 2009, *Lindiwe Mazibuko and Others v City of Johannesburg and Others*, Case CCT 39/09 edn, [2009] ZACC 28, Johannesburg.

Cornes, R., 1946- 1986, *The theory of externalities, public goods, and club goods*, Cambridge {Cambridgeshire}: New York Cambridge University Press, Cambridge {Cambridgeshire} : New York.

Crowards, T. 1995, *Nonuse Values and Economic Valuation of the Environment: A Review*, Center for Social and Economic Research on the Global Environment, University of East Anglia, UK.

CSIR. 2000, *Guidelines for human settlement planning and design: The red book*, CSIR Building and Construction Technology.

de Villiers, S. 2007, "The deteriorating nutrient status of the Berg River, South Africa", *Water SA*, vol. Vol. 33, no. No. 5, pp. 659-664.

de Waal, D. 2003, *Prospects for the Poor. Water Reforms and Private Sector Participation in Dar es Salaam, Tanzania*, WaterAid, London, UK.

Del Mistro, R. & Hensher, D., A. 2009, "Upgrading Informal Settlements in South Africa: Policy, Rhetoric and what Residents really Value.", *Housing Studies*, vol. 24, no. 3, pp. 333-354.

Department of Transport. 2007, *The Option Values Sub-Objective*, Transport Analysis Guidance edn, United Kingdom.

Dungumaro, E.W. 2007, "Socioeconomic differentials and availability of domestic water in South Africa", *Physics and Chemistry of the Earth, Parts A/B/C*, vol. 32, no. 15-18, pp. 1141-1147.

DWAE. 2009, *Water Services National Information System* [Homepage of Department of Water Affairs and Environment], [Online]. Available: http://www.dwaf.gov.za/dir_ws/wsnis/default.asp?nStn=wsnisindex [2009, June, 23].

DWAF 1994, *Water an indivisible national asset*, Water and Sanitation Policy edn, White Paper, Cape Town, South Africa.

DWAF. 2001, *Managing the Water Quality Effects of Settlements: The Economic Impact of Pollution in Two Towns*, Department of Water Affairs and Forestry, Pretoria, South Africa.

Edwards, S.F. 1992, "Rethinking existence values", *Land Economics*, vol. 68, no. 1, pp. 120.

Emmanuel, V.J.,Dr 1994, "Affordable Water Supply and Sanitation; Water and Economic Development", *20th WEDC Conference* WEDC, Loughborough University, pp. 7.

Esrey, S., A., Potash, J., B., Roberts, L. & Shiff, C. 1990, *Health Benefits from Improvements in Water Supply And Sanitation: Survey and Analysis of the Literature on Selected Diseases*, US Agency for International Development, Washington DC.

Estache, A. 2004, "Emerging Infrastructure Policy Issues in Developing Countries", *INFVP, The World Bank*, vol. WPS 3442.

Flyvbjerg, B. 2004, "Phronetic planning research; theoretical and methodological reflections ", *Planning theory and practice*, vol. 5, pp. 283-306.

Flyvbjerg, B. 2006, "Five misunderstandings about case-study research", *Qualitative Inquiry*, vol. 12, no. 2, pp. 219-245.

Foster, V., Gómez-Lobo, A. & Halpern, J. 2000, *Designing Direct Subsidies For Water and Sanitation Services Panama: A Case Study*, World Bank.

Fowkes, T. & Wardman, M. 1988, "The Design of Stated Preference Travel Choice Experiments: With Special Reference to Interpersonal Taste Variations", *Journal of Transport Economics and Policy*, vol. 22, no. 1, Stated Preference Methods in Transport Research, pp. 27-44.

Gardner Pinfold Consulting Economists Ltd., Renzetti, S., Cairns, R. & Grafton, Q. 2002, *Monitoring the Value of Natural Capital: Water*, Environment Canada and Statistics Canada, Canada.

Geurs, K., Haaijer, R. & Wee, V., Bert. 2006, "Option Value of Public Transport: Methodology for Measurement and Case Study for Regional Rail Links in the Netherlands", *Transport Reviews*, vol. 26, no. 5, pp. 613-643.

GKW Consult., Multi Konsult. & Aqua Consult. 2003, *Feasibility study for the component of water supply for informal settlements in Kampala*, NWSC, Kampala.

Goldberg, K., Kula. S, Mhlalisi, M., Ngali, N., Ngesi, Z. 2009, "The Water Dialogues: Cape Town Case Study", Final Report [Online]. Available: http://www.health-e.org.za/documents/2c8d07c15d058ee9fbd00ae988637a63.pdf[2012, 09/11].

Goldblatt, M. 1999, "Assessing the Effective demand for Improved Water Supplies in Informal Settlements: A Willingness to pay survey in Vlakfontein and Finetown, Johannesburg", *Geoforum*, vol. 30, pp. 27-41.

GoU. 2007, *State of Uganda Population Report 2007: Planned Urbanisation for Uganda's Growing Population*, Government of Uganda.

GoU. 2006, *Poverty Eradication Action Plan (PEAP/PRSP)*, Ministry of Finance, Planning and Economic Development, Kampala.

Green, C.:. 2003, *The Handbook of Water Economics: Principles and Practice*, Wiley.

Greenley, D.A., Walsh, R.G. & Young, R.A. 1981, "Option Value: Empirical Evidence From a Case Study of Recreation and Water Quality", *The Quarterly Journal of Economics*, vol. 96, no. 4, pp. 657-673.

Grigg, Neil, S, PhD, PE. 2008, "Social Impacts of Water Management" in *Total Water management: Practices for a Sustainable Future* American Water Works Association, Denver, CO, pp. 191-205.

Grigg, Neil, S, PhD, PE.: 2008, "Value and Cost of Water" in *Total Water management: Practices for a Sustainable Future* American Water Works Association, 2008, pp. 137-159.

Guha, S. 2008, "Valuation of Clean Water supply by Willingness to Pay Method in a Developing Nation: A Case Study in Calcutta, India", *The Journal of Young Investigators*, [Online], vol. 19, no. 5, pp. 26/11/2008. Available from: http://www.jyi.org/research/re.php?id=1295.

Gulyani, S., Talukdar, D. & Mukami, K. 2005, "Universal (Non)service? Water Markets, Household Demand and the Poor in Urban Kenya", *Urban Stud*, vol. 42, no. 8, pp. 1247-1274.

Gunatilake, H., Yang, J., Pattanayak, S. & Van den Berg, C. 2006, *Willingness to Pay and Design of Water Supply and Sanitation Projects: A Case Study*, Asian Development Bank, Manila, Philippines.

Gunatilake, H., Yang, J., Pattanayak, S. & Choe, K.A. 2007, *Good Practices for Estimating Reliable Willingness-to-Pay Values in the Water Supply and Sanitation Sector*, Asian Development Bank, Philippines.

GWP. 2008, *Dublin Statements and Principles* [Homepage of Global Water Partnership], [Online]. Available: http://www.gwpforum.org/servlet/PSP?iNodeID=1345 [2008, 11/5].

Haller, L., Hutton, G. & Bartram, J. 2007, "Estimating the Costs and Health Benefits of Water and Sanitation Improvements at Global Level ", *Journal of Water and Health*,

Hanemann, M. 2005, *The Value of Water*, University of California, Berkeley.

Hanks, J., Hamann, R. & Sayers, V. 2007, *Corporate Social Responsibility and the United Nations Global Compact in South Africa*, National Business Initiative, Cape Town, South Africa.

Hanley, N., MacMillan, D., Wright, R.E., Bullock, C., Simpson, I., Parsisson, D. & Crabtree, B. 1998, "Contingent Valuation Versus Choice Experiments: Estimating the Benefits of Environmentally Sensitive Areas in Scotland", *Journal of Agricultural Economics*, vol. 49, no. 1, pp. 1-15.

Harpman, D., A., Welsh, M., P. & Bishop, R., C. 1994, *Nonuse Economic Value: Emerging Policy Analysis Tool*, Research Report edn, U.S. Bureau of Reclamation, Denver, CO.

Hemson, D., Kulindwa, K., Lein, H. & Mascarenhas, A. (eds) 2008, *Poverty and Water: Explorations of the Reciprocal Relationship*, 1st Edn edn, CROP International Studies in Poverty Research, International Social Science Council, Zed Books Ltd, London & New York.

Hensher, D., Rose, J. & Greene, W. 2005, *Applied Choice Analysis: A Primer*, Cambridge University Press, Cambridge, UK.

Heun, J. n.d, *POWER Water Wisdom Book: An Anthology of Water Wisdom*, UNESCO-IHE, 2005.

Holland, A., Sjolander.: 2005, *The Water Business: Corporations Versus People*, Zed Books, New York.

Huber, J. & Zwerina, K. 1996, "The Importance of Utility Balance in Efficient Choice Designs", *Journal of Marketing Research*, vol. 33, no. 3, pp. pp. 307-317.

Humphreys, R.M. 2003, *Assessing indirect use and non-use values for rail transport using expressed preference techniques*, Institute for Transport Studies.

Hutton, G. 2012, *"Perspective Paper" on the Sanitation and Water Challenge Paper*, Copenhagen Consensus 2012.

Hutton, G. & Bartram, J. 2008, *Regional and Global Costs of Attaining the Water Supply and Sanitation Target (Target 10) of the Millennium Development Goals*, World Health Organisation, Geneva.

Hutton, G. & Haller, L. 2004, *Evaluation of the costs and Benefits of Water and Sanitation Improvements at the Global Level*, World Health Organisation, Geneva.

Hutton, G., Haller, L, Bartram, J. 2008, *Economic and Health Effects of Increasing Coverage of Low Cost Water and Sanitation Interventions*, Swiss Tropical Institute and World Health Organisation, Geneva.

ICFW 2001, *"Water – a Key to Sustainable Development* ", *Internationa*l *Conference on Fresh Water* Bonn, Germany.

ICWE 1992, "*The Dublin Statement on Water and Sustainable Development*", *Dublin International Conference on Water and the Environment* World Meteorogical Organisation, Geneva.

Isingoma, D. 2005, "Linking tariff structure changes to improved utility performance: the case of NWSC", *31st WEDC International Conference* WEDC, Kampala, Uganda

Juuti, P., Katko, T. & Vuorinen, H. (eds) 2007, *Environmental History of Water: Global views on community water supply and sanitation*, IWA Publishing, London.

Jansen, A.O. &Schulz, C-E. 2006, *Water demand and the urban poor: A study of the factors influencing water consumption among households in Cape Town, South Africa.*Working Paper No 02/06 in Economics and Management Series, January, Department of Economics and Management, Norwegian College of Fishery Science University of Tromsø, Norway.

Katukiza, A.Y., Ronteltap, M., Oleja, A., Niwagaba, C.B., Kansiime, F. & Lens, P.N.L. 2010, "Selection of sustainable sanitation technologies for urban slums — A case of Bwaise III in Kampala, Uganda", *Science of The Total Environment*, vol. 409, no. 1, pp. 52-62.

KCC, 2008, *Kampala City Profile*, Presentation, Kampala.

KCC. 2007, *Kampala Urban Sanitation Program*, Kampala City Council, Kampala, Uganda.

KCC. 2002, *Kampala City Council*, Planning Department, Kampala.

Kniivilä, M. 2006, "Users and non-users of conservation areas: Are there differences in WTP, motives and the validity of responses in CVM surveys?", *Ecological Economics*, vol. 59, no. 4, pp. 530-539.

Kocur, G., Alder, T., Hyman, W. & Aunet B. 1982, *Guide to forecasting travel demand with direct utility assessment*, United States Department of Transportation, Urban Mass Transportation, Washington DC.

Kolokytha, E.G., Mylopoulos, Y.A. & Mentes, A.K. 2002, "Evaluating demand management aspects of urban water policy—A field survey in the city of Thessaloniki, Greece", *Urban Water,* , no. 4, pp. 391-400.

Komives, K., Halpern, J., Foster, V., Wodon, Q. & Abdullah, R. 2007, "Utility Subsidies as Social Transfers: An Empirical Evaluation of Targeting Performance", *Development Policy Review,* , no. 6, pp. 659-679.

Kontoleon, A. & Yabe, M. 2003, "Assessing the Impacts of Alternative 'Opt-out' Formats in Choice Experiment Studies: Consumer Preferences for Genetically Modified Content and Production Information in Food", *Journal of Agricultural Policy Research,* vol. 5, pp. 1-43.

Koppelman, F S. and Bhat, Chandra. 2006, *A Self-Instructing Course in Mode Choice Modelling: Multinomial and Nested Logit Models.*, Prepared for U. S. Department of Transportation, Federal Transit Administration.

Krutilla, J., V. 1967, "Conservation Reconsidered", *American Economic Review*, vol. 57, no. 4, pp. 777-786.

Laird, J., Batley, R., Nash, C. & Geurs, K. 2006, *Option Values, Nonuse Values and Transport Appraisal: Final Report*, Institute for Transport Studies, Leeds, UK.

Laird, J., Geurs, K. & Nash, C. 2009, "Option and non-use values and rail project appraisal", *Transport Policy,* vol. 16, no. 4, pp. 173-182.

Lancaster, K.J. 1966, "A New Approach to Consumer Theory", *Journal of Political Economy*, vol. 74, no. 2, pp. 132.

Tissington, K., Langford, M., Dettmann, M., Dugard, J. & Conteh, S. 2008, *Water Service Fault Lines: An Assessment of South Africa's Water and Sanitation Provision across 15 Municipalities*, CALS, COHRE, NCHR, Johannesburg.

Larson, D., M. & Loomis, J., B. 1993, "Towards measuring use and nonuse values from observation of related market behaviour and contingent valuation responses: some preliminary results", *W-133 Benefits and Costs Transfer in Natural Resource Planning. Sixth Interim Report*, ed. J. Bergstrom C., Department of Agricultural and Applied Economics, University of Georgia, .

Le Blanc, D. 2007, *A Framework for Analyzing Tariffs and Subsidies in Water Provision to Urban Households in Developing Countries*, Division for Sustainable Development, United Nations.

Loomis, J., B. 1997, "Use of non-market valuation studies in water resource management assessments", *Water Resources Update,* vol. 109, pp. 5-9.

Loomis, J. 2006, "Importance of Including Use and Passive Use values of River and Lake Restoration", *Journal of Contemporary Water Research & Education, ,* no. 134, pp. 4--8.

Loomis, J. 1987, *An economic evaluation of public trust resources of Mono Lake, Ecology Report 30*, College of Agricultural and Environmental Sciences, University of California, Davis.

Loots, L., J. 2004, "Equity and the Local Government Equitable Share in South Africa", *10 Years of the FFC: Consolidation for Greater Equity* Financial and Fiscal Commission, Cape Town, South Africa, 10th -12th August 2004.

Louviere, J.J., Hensher, D.A. & Swait, J. 2000, *Stated Choice Methods, Analysis and Application,* Cambridge University Press, Cambridge.

Louviere, J.J. & Woodworth, G. 1983, "Design and Analysis of Simulated Consumer Choice or Allocation Experiments: An Approach Based on Aggregate Data", *Journal of Marketing Research,* vol. 20, no. 4, pp. 350-367.

MacDonald, D., A. 2002, "The Theory and Practice of Cost Recover in South Africa" in *Cost Recovery and the Crisis of Service Delivery in South Africa*, eds. D. MacDonald A. & J. Pape, Human Sciences Research Council, Cape Town, pp. 17-37.

MacFadden, D., L. 2000, "Economic Choices", *Economic Sciences,* , pp. 330--365.

Mackenzie, J. 1993, "A Comparison of Contingent Preference Models", *Agricultural and Applied Economics Association,* vol. 75, no. No. 3, pp. 593-603.

Mader, P. 2011, "Making the Poor Pay for Public Goods via Microfinance: Economic and Political Pitfalls in the Case of Water and Sanitation", *Max Planck Institute for the Study of Societies*.

Mjale, M. 2002, "Regulatory guidelines for urban upgrading: towards effecting pro-poor change", Intermediate Technology Development Group, Schumacher Centre for Technology and Development, United Kingdom

Mäler, K. 1971, "A Method of Estimating Social Benefits from Pollution Control", *Swedish Journal of Economics,* vol. 73, no. 1, pp. 121.

Martine, G. 2011, "Preparing for sustainable urban growth in developing areas" in *Population distribution, urbanization, internal migration and development: an international perspective*, eds. Department of Economic and Social Affairs. edn, United Nations, pp. 6-30.

Massarutto, A. 2009, "Assessing financial sustainability of water and sanitation services", *1st International Forum on Regulation of Water Services and Sustainability* Dipartimento di scienze economiche, Università di Udine IEFE, Università Bocconi, Milano, January 21, 2009.

McDonald, D.A. 2002, "No Money, No Service. South Africa's Poorest Citizens Lose out Under Attempts to Recover Service Costs for Water and Power", *Alternatives Journal,* vol. 28, no. 2, pp. 16-20.

McFadden, D., 2001, "Economic Choices", *American Economic Review,* vol. 91, pp. 351-378.

McFadden, D., 1974, "Conditional logit analysis of qualitative choice behaviour" in *Frontiers in Econometrics*, ed. P. Zarembka, Academic Press, New York, pp. 105-142.

Mels, A., Castellano, D., Braadbaart, O., Veenstra, S., Dijkstra, I., Meulman, B., Singels, A., Wilsenach,J.A.2003, *Sanitation services for the informal settlements of Cape Town, South Africa*, Desalination 251 (2010), 330-337

Merino-Castello, A. 2003, *Eliciting Consumers Preferences using Stated Preference Discrete Choice Models: Contingent Ranking versus Choice Experiment*, Chapter in PhD Thesis edn, Universitat Pompeu Fabra, Barcelona, Spain.

Meyer, M. n.d, *POWER Water Wisdom Book: An Anthology of Water Wisdom*, UNESCO-IHE, 2005.

Meyerhoff, J. & Liebe, U. 2006, *Status-Quo Effect in Choice Modelling: Protest Beliefs, Attitudes, and Task Complexity*, Institute for Landscape and Environmental Planning Technische Universität Berlin, Germany.

Mitchell, C., Fane, S., Willetts, J., Plant, R. & Kazaglis, A. 2007, *Costing for Sustainable Outcomes in Urban Water Systems. A Guidebook*, Cooperative Research Centre for Water Quality and Treatment, Salisbury, Australia.

Mitchell, R.C. & Carson, R.T. 1989, "Using Surveys to Value Public Goods: The Contingent Valuation Method", *Resources for the Future*, .

Mjoli, N., Sykes, G. & Jooste, T. 2009, *Towards the Realisation of Free Basic Sanitation: Evaluation, Review and Recommendations*, Water Research Commission, South Africa.

MNR. 1995, *Uganda Water Action Plan*, Policy document edn, Ministry of Natural Resources, Uganda, Kampala, Uganda.

Montes de Oca, G.S., Bateman, I.J., Tinch, R. & Moffatt, P.G. 2008, *Assessing the Willingness to Pay for Maintained and Improved Water Supplies in Mexico City*, ESRC Center for Social and Economic Research on the Global Environment, UK.

Moodley, S. 2000, "Investigating Total Economic Burden: South Africa's Diarrhoeal Disease Burden in 1995 ", *Johannesburg: Group for Environmental Monitoring*, .

Moreno, E. L. 2011, "Living with shelter deprivations: Slum dwellers in the world" in *Population distribution, urbanization, internal migration and development: an international perspective*, eds. Department of Economic and Social Affairs. edn, United Nations, pp. 31-53.

Mosdell, T. 2006, "Free basic services: The evolution and impact of free basic water policy in South Africa" in *Democracy and Delivery Urban Policy in South Africa*, ed. Udesh Pillay, Richard Tomlinson, Jacques du Toit, HSRC Press, South Africa, pp. 283-301.

Moss, J., Wolff, G., Gladden, G. & Guttieriez, E. 2003, *Valuing Water for Better Governance: How to Promote Dialogue to Balance Social, Environmental and Economic Values?*, Business and Industry CEO Panel for Water.

MoWE 2008, *Water and Sanitation Sector Report, 2008*, Ministry of Water and Environment, Kampala, Uganda.

MoWE. 2006, *Water and Sanitation Sector Performance Report, 2006*, Ministry of Water and Environment, Kampala, Uganda.

Mugabi J & Njiru C 2005, "Maximising the 'Value' of Improved Water Services in Small Towns", *Maximising the Benefits from Water and Environmental Sanitation* WEDC, Loughborough University, UK, pp. 204-207.

Muhairwe, W. 2007, *Ensuring Sustainable Access For the Poor through Internal Revenue Generation: Water and Sanitation. The Case of National Water and Sewerage Corporation.*, Presentation edn, National Water and Sewerage Corporation, Kampala.

Muller, M. 2008, "Free basic water -- a sustainable instrument for a sustainable future in South Africa", *Environment and Urbanization,* vol. 20, no. 1, pp. 67-87.

MWLE. 1999, *The National Water Policy*, Policy document edn, Ministry of Water, Lands and Environment, Uganda, Kampala, Uganda.

Mycoo, M. 1996, *Utility Performance and Consumer Willingness to Pay for Water in the early 1990s: Case Study of Trinidad*, Unpublished Research paper edn, The University of the West Indies, St. Augustine, Trinidad.

Nam, P., K & Son, T., V., H. 2004, *Household demand for Improved Water Services in Ho Chi Minh City: A Comparison of Contingent Valuation and Choice Modelling*, Environmental Economics Unit, University of Economics–Ho Chi Minh City.

Nieuwoudt, W.l., Backeberg, G.R. & Du Plessis, H.M. 2004, "The Value of Water in the South African Economy: Some Implications", *Agrekon,* vol. 43, no. 2, pp. 162-183.

Nilsson, D. 2006a, "A heritage of unsustainability? Reviewing the origin of the large-scale water and sanitation system in Kampala, Uganda ", *Environment and Urbanization,* no. 18, pp. 369.

Nilsson, D. 2006, "A heritage of unsustainability? Reviewing the origin of the large-scale water and sanitation system in Kampala, Uganda", *International Institute for Environment and Development*, vol. 18, no. 2, pp. 369-385.

Nilsson, D. 2006, *Water for a few: a history of urban water and sanitation in East Africa*, School of architecture and the built environment Royal Institute of Technology, KTH.

Nilsson, D. 2005, "The Evolution of Urban Water and Sanitation in East Africa from a Public Goods Perspective" in *African Water Histories: Transdisciplinary Discourses*, ed. J.W.N. Tempelhoff, Vaal Triangle Faculty, North-West University, Vanderbijlpark, South Africa, pp. 317-345.

Nleya, N. 2008, "Development policy and water services in South Africa: an urban poverty perspective", *Development Southern Africa,* vol. 25, no. 3, pp. 269--281.

Ntengwe, F.W. 2004, "The impact of consumer awareness of water sector issues on willingness to pay and cost recovery in Zambia", *Physics and Chemistry of the Earth, Parts A/B/C,* vol. 29, no. 15-18, pp. 1301-1308.

NWSC. 2009, *National Water and Sewerage Corporation: Annual Report 2008-2009*, National Water and Sewerage Corporation, Kampala.

NWSC. 2008, *National Water and Sewerage Report: Annual report 2007/2008*, National Water and Sewerage Corporation, Kampala, Uganda.

NWSC. 2007, *Water Supply and Sanitation Services for the Urban Poor in Kagugube Parish, Central Division –Kampala*, National Water and Sewerage Corporation, Kampala.

OECD. 2011b, *Meeting the Challenge of Financing Water and Sanitation: Tools and Approaches, OECD Studies on Water*, OECD Publishing.

OECD. 2011a, *Benefits of Investing in Water and Sanitation: An OECD Perspective*, OECD Publishing.

OECD. 2010, *Pricing Water Resources and Water and Sanitation Services*, OECD Publishing.

OECD. 2009, *Managing Water for All: An OECD Perspective on Pricing and Financing*, OECD Publishing, Paris.

Ofwat Tariffs Team 2005, *Affordability and the structure of Household Water Charges - Options*, Briefing Note edn, UK.

Ojeda, M.I., Mayer, A.S. & Solomon, B.D. 2008, "Economic valuation of environmental services sustained by water flows in the Yaqui River Delta", *Ecological Economics,* vol. 65, no. 1, pp. 155-166.

Okun, D., A. 1988, "Value of Water Supply and Sanitation in Development: AN Assessment", *American Journal of Public Health,* vol. 78, no. 11, pp. 1463-1467.

Ostrom, E. & Ostrom, V. 1977, "Public goods and public choices" in *Alternatives for delivering public services*, ed. Savas, Westview Press, Boulder, CO, pp. 7-49.

Otiso, K.M. 2003, "State, voluntary and private sector partnerships for slum upgrading and basic service delivery in Nairobi City, Kenya" in *Cities*, vol. 20, No. 4 221-229.

Painter, K., M., Scott II, R., Douglas., Wandschneider, P., R. & Casavant, K., L. "Using Contingent Valuation to Measure User and Nonuser Benefits: An Application to Public Transit", *Review of Agricultural Economics*, vol. 24, no. 2, pp. 394-409.

Palmer Development Group. 2005, *Strategic and Operational Review of Conditional Grants*.

Parikh, P. 2008, *Impact of Integrated Water and Environmental SanitationInfrastructure on Poverty Alleviation*, Cambridge University Engineering Department.

Pattanayak, S., K., Berg, C., van den., Yang, J., & Houtven, G.V. 2006, *The Use of Willingness to Pay Experiments: Estimating demand for piped water connections in Sri Lanka*, World Bank Policy Research Working Paper 3818 edn, The World Bank, Washington DC.

PDG 2001, *Free Basic Water Implementation Strategy. Case Study: Nkomazi*, Department of Water Affairs and Forestry, South Africa.

Pearce, D. &Özdemiroglu, E. 2002, *Economic valuation with Stated Preference Techniques: Summary Guide*, Department for Transport, Local Government and the Regions, London.

Pegram, G.C., Rollins, N. & Espey, Q. 24, "Estimating the Costs of Diarrhoea and Epidemic Dysentry in Kwazulu-Natal and South Africa", *Water SA*, vol. 1, no. 11, pp. -20.

PEM Consult. & SEREFACO. 2008, *Strategic Investment Planning Framework*, National Water and Sewerage Corporation, Kampala, Uganda.

Peters, K. & Oldfield, S. 2005, "The Paradox of 'Free Basic Water' and Cost recovery in Grabouw: Increasing Household Debt and Municipal Financial Loss", *Urban Forum*, vol. 16, no. 4, pp. 313-335.

Pillay, U., Tomlison, R. & Du Toit, J. (eds) 2006, *Democracy and Delivery; Urban Policy in South Africa*, HSRC Press, South Africa.

Pollack, M. 2008, 2008/11/14-last update, *City's Indigent Policy* [Homepage of City of Cape Town], [Online]. Available: http://www.capetown.gov.za/en/Pages/Indigentpolicy.aspx [2011, March/28].

Porciuncula, A.D. 2009, "Creative financing solution for water supply and sanitation in the Philippines", *Ocean & Coastal Management*, vol. 52, no. 7, pp. 374-377.

Portney, P.R. 1994, "The Contingent Valuation Debate: Why Economists Should Care", *The Journal of Economic Perspectives*, vol. 8, no. 4, pp. pp. 3-17.

Prest, A.R. & Turvey, R. 1965, "Cost-Benefit Analysis: A Survey", *The Economic Journal*, vol. 75, no. 300, pp. 683-735.

Pruss-Ustun, A., Boss, R., Gore, F. & Bartram, J. 2008, *Safer Water, Better Health: Costs, benefits and Sustainability of Interventions to Protect and Promote Health*, World Health organisation, Geneva.

Randal, A. 1986, "Human Preferences, Economics and the Preservation of Species" in *The Preservation of Species*, ed. B.G. Norton, Princeton University Press, Princeton.

Rao, G.,M. & Khumalo, B. 2004, "Sharing the Cake: A review of Provincial Equitable Share Formula in South Africa", *10 Years of the FFC: Consolidation for Greater Equity* Financial and Fiscal Commission, Cape Town, South Africa, 10th-12th August 2004.

Raucher, R., S., Chapman, D., Henderson, J., Hagenstad, M., L., Rice, J., Goldstein, J., Huber-Lee, A., DeOreo, W., Mayer, P., Hurd, B., Linsky, R., Means, E. & Renwick, M. 2005, *The Value of Water: Concepts, Estimates and Applications for Water Managers*, Awwa Research Foundation, Denver, CO.

RIC. 2005, *Customer Willingness to Pay for Changes in Water, Wastewater and Electricity Services in Trinidad and Tobago - A Survey*, Regulated Industries Commission.

River Health Programme 2005, *State of Rivers Report: Greater Cape Town's Rivers*, Department of Water Affairs and Forestry, Pretoria.

Rockey, V. (ed) 2004, *The Corporate Social Investment Handbook*, 7th edn, Trialogue, Cape Town, South Africa.

Rogers, P., Bhatia, R. & Huber, A. 1998, *Water as a Social and Economic Good: How to put the Principle into Practice*, Global Water Partnership/Swedish International Development Cooperation Agency, Stockholm, Sweden.

Rolfe, J. & Bennett, J. 2009, "The impact of offering two versus three alternatives in choice modelling experiments", *Ecological Economics*, vol. 68, no. 4, pp. 1140-1148.

Rose, J.M., Bliemer, M.C.J., Hensher, D.A. & Collins, A.T. 2008, "Designing efficient stated choice experiments in the presence of reference alternatives", *Transportation Research Part B: Methodological*, vol. 42, no. 4, pp. 395-406.

Ruma, P. 2008, *Protests in Bangladesh capital over water shortage* , Wed Apr 23, 2008 edn, Reuters: Business and Finance, UK.

Rybeck, R. 2004, "Using Value Capture to Finance Infrastructure and Encourage Compact Development", *Public Works Management & Policy*, vol. 8, no. 4, pp. 249-260.

SACN 2006, *State of the Cities Report 2006* [Homepage of Johannesburg: SA Cities Network], [Online]. Available: www.sacities.net.

Sanders, L., D., Walsh, R., G. & Loomis, J., B. 1990, "Toward Empirical Estimation of the Total Value of Protecting Rivers", *Water resources Research*, vol. 6, no. 7, pp. 1345-1357.

Saunders, L. & Del Mistro, R. 2004, "The Impact of Level of Service on the Health of a Community", *Creating Innovative Solutions in Public Sector Financing* IMESA, 2004, pp. 77-85.

Schnabel, B. 2009, *The microeconomic impacts of diarrhoeal infections on rural and suburban households in Uganda.* , International Development Studies.

Schultz, J. 2000, *Bolivia's Water War Victory*, Autumn 2000 edn, Earth Island Journal, UK.

Schwartz, B., J. & Johnson, R., W. 1992, *Maximising the Economic Impact of Urban Water Supply and Sanitation Investments*, US Agency for International Development, Washington DC.

Serageldin, I. 1994, *Water Supply, Sanitation and Environmental Sustainability: The Financing Challenge*, The International Bank for Reconstruction and Development/World Bank, Washington DC.

Serageldin, I. & Steer, A. 1994, *Making Development Sustainable: From Concepts to Action*, The World bank, Washington DC.

Shomenthree, M. 2000, "Investigating Total Economic Burden: South Africa's Diarrhoeal Disease Burden in 1995 ", *Johannesburg: Group for Environmental Monitoring,* .

Sidley, P. 2005, *Typhoid outbreak prompts protests over inadequate water system Johannesburg*, BMJ 2005;331:655 (24 September), edn, IRC, Netherlands.

Smith, L. 2009, *Municipal Compliance with Water Services Policy: A Challenge for Water Security*, Development Planning Division, Development Bank of Southern Africa, Midrand.

Smith, L. & Hanson, S. 2003, "Access to Water for the urban Poor in Cape Town: Where Equity Meets Cost Recovery", *Urban Studies*, vol. 40, no. 8, pp. 1571-1548.

Smith, A. 2010, "Wealth of Nations" in *The Two Narratives of Political Economy* John Wiley & Sons, Inc., , pp. 109-160.

Smith, R.D. 2007, "Use, option and externality values: are contingent valuation studies in health care mis-specified?" *Health economics*, vol. 16, no. 8, pp. 861-869.

Smith, V.K. 1987, "Nonuse Values in Benefit Cost Analysis", *Southern Economic Journal*, vol. 54, no. 1, pp. 19-26.

Snowball, J.D., Willis, K.G. & Jeurissen, C. 2008, "Willingness to pay for water service improvements in middle - income urban households in South Africa: a stated choice analysis", *South African Journal of Economics, The*, vol. 76, no. 4, pp. 705-720.

Standard Bank 2011, *Standard Bank Forex Closing Indication Rates for December 30, 2011* [Homepage of Standard Bank], [Online]. Available: http://ws15.standardbank.co.za/finSnapShot/GetforexServlet [2012, 08/12].

STATSA (2009) Producer price Index [Online]. Available: http://www.statssa.gov.za/keyindicators/ppi.asp [2012, 08/12]

Stevens, T.H., Belkner, R., Dennis, D., Kittredge, D. & Willis, C. 2000, "Comparison of contingent valuation and conjoint analysis in ecosystem management", *Ecological Economics*, vol. 32, no. 1, pp. 63-74.

Tempelhoff, J.W.N. 2012, "From Makhaza to Rammulotsi: Reflections on South Africa's "toilet election" of 2011", *Historia*, vol. 57, pp. 82-102.

Thompson, J., Porras, I.T., Tumwine, J.K., Mujwahuzi, M.R., Katui-Katua, M., Johnstone, N. & Wood, L. 2001, *Drawers of Water II: 30 years of change in domestic water use and environmental health in East Africa*, IIED, London.

Thorson, J. 2005, *POWER Water Wisdom Book: An Anthology of Water Wisdom* , UNESCO-IHE.

Thurman, S.:. 1999, *Review of Rates, Service Charges and Connection Fees across Metropolitan Cape Town*, Development Action group, Cape Town.

Tumwine, J.K., Thompson, J., Katua-Katua, M., Mujwajuzi, M., Johnstone, N., Wood, E. & Porras, I. 2002, "Diarrhoea and effects of different water sources, sanitation and hygiene behaviour in East Africa", *Tropical Medicine and International Health*, vol. 7, no. 9, pp. 750-756.

Turner, K., R. 1999, "The Place of Economic Values in Environmental Valuation" in *Valuing Environmental Preferences*, eds. I. Bateman J. & K. Willis G., 1st edn, Oxford University press, Oxford, UK, pp. 17-41.

Tyson, W.J. 1991, "Who Profits from Public Transport? Non-user Benefits: the Hidden Treasures for the Community", *49th International Congress Stockholm 1991*, ed. International Commission for Transport Economics, International Union (Association) of Public Transport, Brussels.

UBOS. *2010 mid-year projected population for Town Councils* [Homepage of Uganda Bureau of Statistics], [Online]. Available: http://www.ubos.org/onlinefiles/uploads/ubos/pdf%20documents/TP52010.pdf [2012, May].

UBOS. 2007, *Uganda Demographic and Health Survey 2006*, Uganda Bureau of Statistics and Macro International, USA, Calverton, USA.

UN CESCR, *General Comment No. 15: The Right to Water (Arts. 11 and 12 of the Covenant), 20 January 2003, E/C.12/2002/11*,Available: http://www.unhcr.org/refworld/docid/4538838d11.html [2012, 08/12].

UN. 1987.*Report of the World Commission on Environment and Development* General Assembly Resolution

UN. 1995, *Copenhagen Declaration on Social Development*, World Summit for Social Development Agreements, the United Nations.

UNDP/WSP. 1999, *Willing to Pay but Unwilling to Charge: Do 'Willing-to-Pay' Studies make a Difference?*, UNDP-World Bank Water and Sanitation Program - South Asia, New Delhi, India.

UN-Habitat. 2011, *State of the World's Cities 2010/2011: Bridging The Urban Divide*, Earthscan Publishing for a Sustainable Future, London. Sterling VA.

UN-Habitat. 2010, *The State of African Cities 2010: Governance, Inequality and Urban Land Markets*, UN-Habitat and UNEP, Nairobi.

UN-Habitat. 2008, *State of the World's Cities 2008/2009: Harmonious Cities*, United Nations Human Settlements Programme (UN-HABITAT), London, UK.

UN-Habitat. 2007, *Situation Analysis of Informal Settlements in Kampala: Kivulu (Kagugube) and Kinawataka (Mbuya 1)*, Un-Habitat, Nairobi.

UNHS. 2006, *Uganda National Household Survey 2005/2006*, Uganda Bureau of Statistics, Kampala, Uganda.

UNICEF & WHO 2012, *Progress on Drinking Water and Sanitation: 2012 Update*, WHO and UNICEF, USA.

UN-Water. & WWAP. 2006, *Water, A Shared Responsibility. Executive Summary*, WWAP-UNESCO, France.

UN-Water/Africa. 2006, *Africa Water Development Report*, Economic Commission for Africa, Addis Ababa, Ethiopia.

Van der Zaag, P. & Savenije, H.H.G. 2006, *Water as an Economic Good: The Value of Pricing and the Failure of Markets*, UNESCO-IHE Institute for Water Education, Delft, The Netherlands.

Veck, GA & Bill, MR 2000, *Estimation of the Residential Price Elasticity of Demand for Water by means of a Contingent Valuation Approach.*, WRC Report.

Wagner, J., C. & Manus, A. 2008, "The Costs and Benefits of Increasing the Free Basic Services Standard", *WISA 2008 Biannual Conference and Exhibition* Sun City, South Africa.

Walker, I., Ordonez, F., Serrano, P. & Halpern, J. 2000, *Pricing, Subsidies and the Poor: Demand for Improved Water Services in Central America*, Policy Research Working Paper edn, World Bank, Washington DC.

Wang, H., Xie, J. & Li, H. 2008, *Domestic Water Pricing with Household Surveys: A Study of Acceptability and Willingness to Pay in Chongqing, China*, The World Bank Sustainable Rural and Urban Development Research Group, Washington DC.

WBCSD 2008, , *Time for business to act* [Homepage of World Business Council for Sustainable Development], [Online]. Available: http://www.wbcsd.org/templates/TemplateWBCSD5/layout.asp?type=p&MenuId=MTU4MQ&doOpen=1&ClickMenu=LeftMenu [2008, 10/24].

Weikard, H. 2002, "The Existence Value Does Not Exist and Non-use Values are Useless", *The 2002 Annual Meeting of the European Public Choice Society* European Public Choice Society, Belgirate-Lago Maggiore, Italy, 4-7 April 2002.

Weisbrod, B.A. 1964, "Collective-Consumption Services of Individual-Consumption Goods", *Quarterly Journal of Economics*, vol. 78, no. 3, pp. 471-477.

Western Cape High Court 2010, *In the High Court of South Africa(Western Cape High Court, Cape Town) Case No: 21332/10*.

Whitehead, J., C. & Blomquist, G., C. 2006, "The use of contingent valuation in benefit-cost analysis" in *Handbook of Contingent Valuation*, eds. A. Alberini & J.R. Kahn, Edward Elgar Publishing, Northampton, MA, pp. 92-115.

Whitehead, J., C. & Blomquist, G., C. 1992, "Economic Benefits of Improved Water Quality: A case study of North Carolina's Tar-Pamlico River", *Rivers*, , no. 3, pp. 170-178.

Whitehead, J., C., Blomquist, G., C., Hoban, T., J. & Clifford, W., B. 1995, "Assessing the Validity and Reliability of Contingent Values: A Comparison of On-Site Users, Off-Site Users and Non-users", *Journal of Environmental Economics and Management*, vol. 29, pp. 238-251.

Whittington, D. 1996, *Administering Contingent Valuation Surveys in developing countries*, Special paper edn, Economy and Environment Program for South East Asia, Singapore.

Whittington, D., Boland, J. & Foster, V. 2002, *Water, Understanding the Basics*, PPIAF, Washington DC.

Whittington, Dale & Hanemann, W. Michael, 2006. "The economic costs and benefits of investments in municipal water and sanitation infrastructure: a global perspective,"

CUDARE Working Paper Series 1027, University of California at Berkeley, Department of Agricultural and Resource Economics and Policy.

Whittington, D. 2002, "Municipal Water Pricing and Tariff Design: A Reform Agenda for Cities in Developing Countries", *Resources for the Future*, , no. Issue Brief, pp. 02-09.

Whittington, D., Briscoe, J., Mu, X. & Barron, W. 1990, "Estimating the Willingness to Pay for Water Services in Developing Countries: A Case Study of the Use of Contingent Valuation Surveys in Southern Haiti", *Economic Development and Cultural Change*, vol. 38, no. 2, pp. 293-311.

WHO 2012, *A Manual for Economic Assessment of Drinking Water Interventions*, World Health Organisation, Geneva.

WHO / UN-Water 2010, *UN-Water Global Annual Assessment of Sanitation and Drinking Water: Targeting Resources for Better Results*, WHO.

WHO. 2012, *UN-water global annual assessment of sanitation and drinking-water (GLAAS) 2012 report: the challenge of extending and sustaining services.* World Health Organisation, Switzerland.

WHO/UNICEF. 2008, *Joint Monitoring Program for Water and Sanitation: Progress on Drinking Water and Sanitation. Special Focus on Sanitation*, UNICEF and WHO, New York, Geneva.

WHO/UNICEF. 2000, *Global Water Supply and Sanitation Assessment 2000*, WHO, UNICEF, Water Supply and Sanitation Collaborative Council.

Willis, K.G. 1989, "Option value and non user benefits of wildlife conservation", *Journal of Rural Studies*, vol. 5, no. 3, pp. 245-256.

Winpenny, J. 2003, *Report of the World Panel for Financing Water Infrastructure: Financing Water for All*, World Water Council.

World Bank (2002), *Sourcebook for poverty reduction strategies, core techniques and crosscutting issues*, Washington DC.

World Bank 2008, *Annual Report 2004; Revitalising Infrastructure*. Available: http://209.85.165.104/search?q=cache:r799g88Nd3cJ:www.worldbank.org/html/extpb/2004/infrastructure.html+infrastructure+investment+needs+for+water+services+in+developing+countries&hl=en&ct=clnk&cd=15&gl=ug [2008, 11/24].

World Bank 2007, *Global Monitoring Report*, World Bank, Washington DC.

World Bank. 2011, *GNI per capita, PPP (current international $)* [Homepage of World Bank], [Online]. Available: http://data.worldbank.org/country/uganda [2012, July/31].

World Bank. 2009, *Urban Water Supply and Sanitation* [Homepage of World Bank, Washington DC], [Online]. Available: http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTWAT/0,,contentMDK:21630640~menuPK:4618199~pagePK:210058~piPK:210062~theSitePK:4602123,00.html [2009, June, 23].

WPP & AfDB 2010, *Guidelines for User Fees and Cost Recovery for Urban Networked Water and sanitation Delivery*, Water Partnership Program, African Development Bank.

WSP 2009, *Guidance Notes on Services for the Urban Poor: A Practical Guide for Improving Water Supply and Sanitation Services*, WSP, World Bank.

WSP. 2004, *The Case for Water and Sanitation Better Water and Sanitation Make Good Fiscal and Economic Sense, and Should be Prominent in PRSPs and Budget allocations*, Water and Sanitation Program, Washington DC.

WSP-Africa. 2006, *Getting Africa on Track to Meet the MDGs on Water and Sanitation: A Status Overview of Sixteen African Countries*, AMCOW.; AfDB.; EUWI.; WSP.; UNDP.; WB.;.

Yang, J.C., Pattanayak, S.K., Jonson, F.R., Mansfield, C., Van den Berg, C. & Jones, K. 2006, *Unpackaging demand for Water Service Quality: Evidence from Conjoint Surveys in Sri Lanka*, World Bank Policy Research Working Paper 3817 edn, World bank.

Young, R.A. 2005, *Determining the Economic Value of Water: Concepts and Method*, Resources for the Future, Washington DC.

Appendices

Towards Improving Levels of Service in Informal Settlements: The Value of Non-User Benefits in Cape Town and Kampala

APPENDIX A

This appendix presents further information on the costs and benefits of improved water and sanitation services

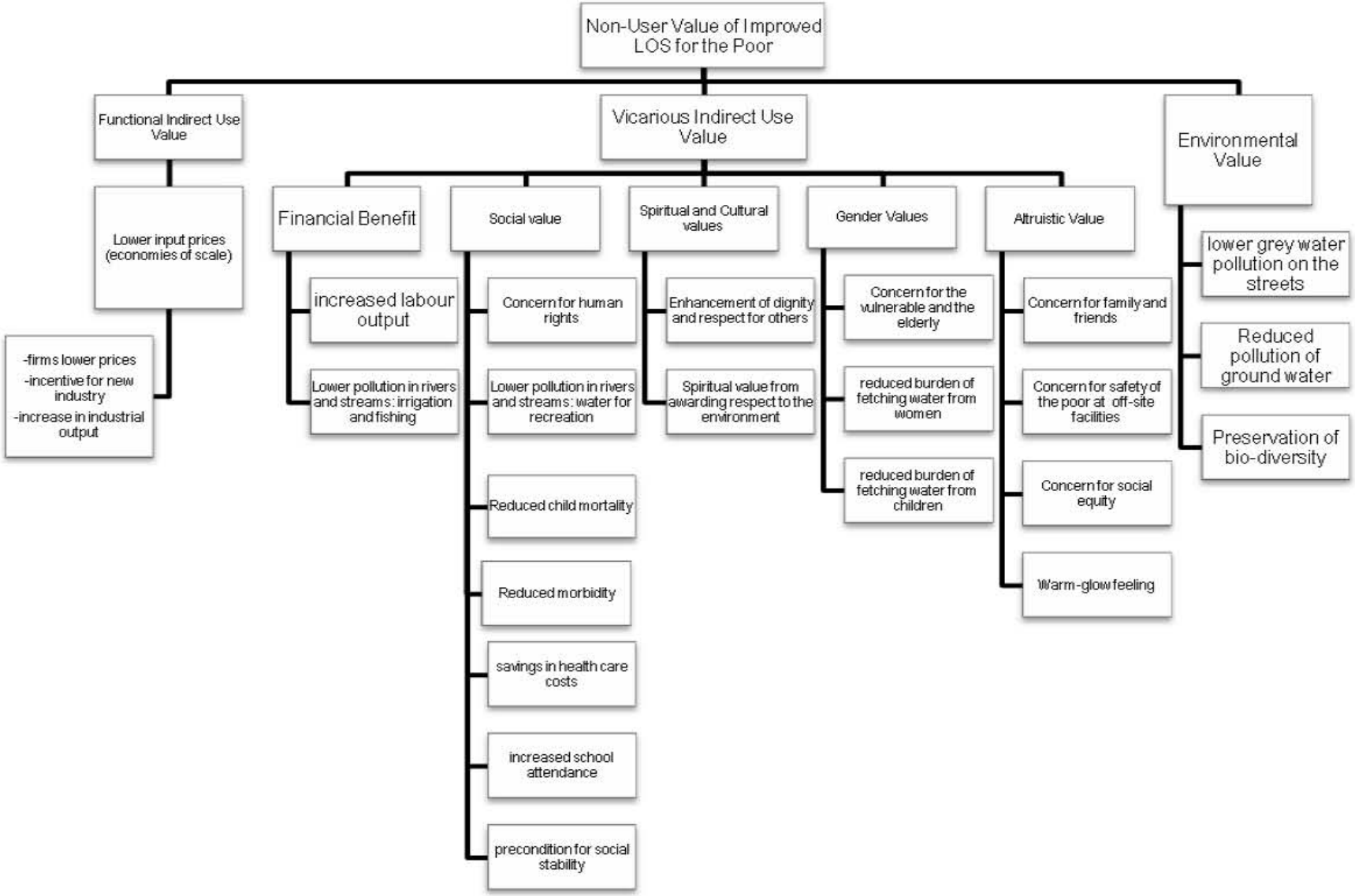

Figure A-1: Components of non-use value of urban water services (Okun, 1998)

The initial survey instrument that was administered to identify the non-user benefits of improving water and sanitation services in informal settlements in Kampala and in Cape Town.

PHASE 1: IDENTIFICATION OF NON-USER BENEFITS

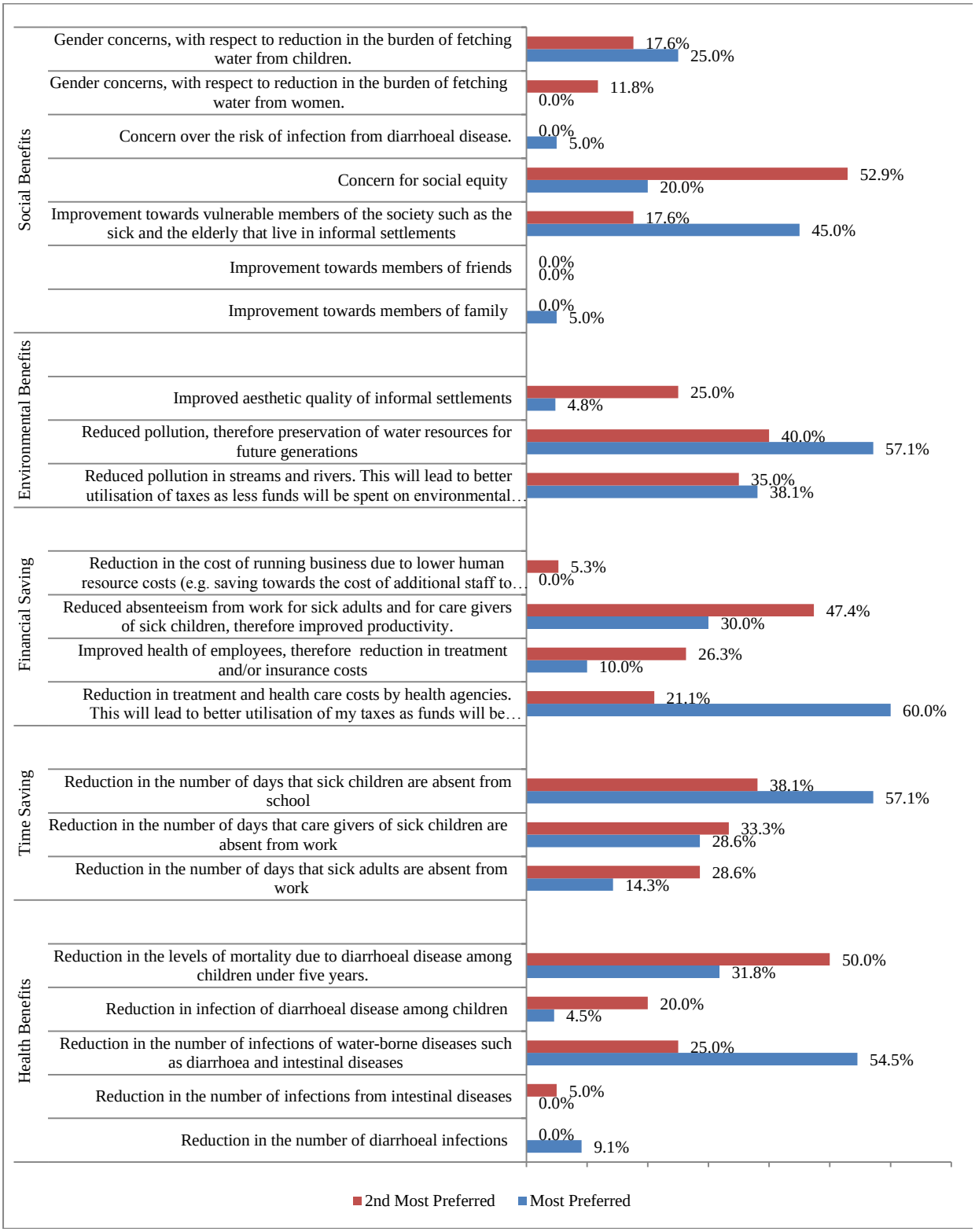

Figure A-2: Ranking of the benefits of improved levels of service in informal settlements - Combined responses from Cape Town and Kampala

Table A-1: Additional benefits as highlighted by the respondents

Benefit Category	Description
Health Benefits	Reduction in the number of cholera infections.
	Reduction in the spread of disease because of lack of hand washing.
Time Saving Benefits	Healthy children go through the schooling system much faster.
Financial Benefits	Clean water is a critical requirement for businesses e.g. agriculture, or the food sector. Provision of clean water is therefore critical for economic development.
	Lower medical expenditure (with corresponding higher productivity for both children & adults) is a saving to both government & domestic households, and promotes higher labour output.
Environmental Benefits	Less pollution in water bodies will lead to the saving of aqua life especially fish which also brings in revenue in the country.
	The long term impacts of ground water pollution fundamentally risk the sustainability of urban economies and the social stability of the urban habitat.
	Pollution causes loss of bio-diversity which risks the sustainability of urban economies and the social stability of the urban habitat.
Social Benefits	Instillation of pride
	Improved services would empower the residents of these communities to the importance of having and maintaining a piped sewer disposal system
	There are synergies to be realised from improving services. A higher quality of life has many benefits in turn – environmental comfort, better health, lower school dropout rates, lower mortality, higher productivity, less financial wastage & higher savings for other expenditure.
	Is an indicator of development of the country.
	Water provided in a dwelling reduces exposure to crime that results from having to go to communal standpipes or toilets. Piped sewer systems are the most important basic service.

APPENDIX B

This appendix presents the survey instrument that was applied in Kampala.

APPENDIX C

This appendix presents the survey instrument that was applied in Cape Town.

APPENDIX D

This appendix presents background information and calculations done in preparation for the surveys and for the analysis of the Kampala data

KAMPALA

Table D-1: Income distribution profile

Household Income(UGX per month)	% of tot. households	No. of households
0 – 150,000	46.70	186,800
151,000 - 200,000	11.6	46,400
>200,000	41.8	167,200
Total		**400,400**

(UBOS, 2007:74)

Table D-2: Service level profile for Kampala City

WATER		
Type	**% of tot. connections**	**No. households**
Unserved		104,000
PSP	3	10,064
Domestic	81	240,648
Government/Institutional	3	
Industry/Commercial	12	
Tot. No.	120,393	
% of tot. population served	**74**	**296,000**
Tot population served	1,480,000	400,000
Tot. Kampala population	2,000,000	
SANITATION		
Sanitation LOS	**%population**	**No. households**
Shared pit latrine	78%	312,000
Own pit latrine	10%	40,000
Septic tank	7%	28,000
Sewered	5%	20,000
Tot.		

(NWSC, 2008)

Table D-3: Number of school days lost

Average number of days missed = 4 days among 87 children (UBOS 2007:30)

Level of Service	Distribution of days lost by LOS	out of 100 children
Communal facilities	56%	2.5
Shared facilities	19%	0.9
Yard facilities	19%	0.9
In-house facilities	7%	0.3

(UBOS, 2007)

Table D-4: Cost of investment for water and sanitation levels of service

	Water supply	unit costs - capital 2008	unit costs - O&M 2008	tot costs - capital 2008	tot costs - O&M 2008
Water	Standpipe (1 tap /50 households)	12,669	1,267	1,317,526,943	131,752,694
	Yard tap (1 tap/4 households)	38,357	3,836	4,375,107,653	437,510,765
	In-house water connection	49,096	4,910	5,600,137,796	560,013,780
Sanitation	Communal Elevated VIP	200,571	20,057	70,601,142,857	7,060,114,286
	Shared Flush Toilet (1 toilet between 7 households)	321,429	32,143	113,142,857,143	11,314,285,714
	Flush toilet in the yard	562,500	56,250	198,000,000,000	19,800,000,000
	In-house flush toilet	2,250,000	225,000	792,000,000,000	79,200,000,000

Table D-5: Annualised cost of investment

Description	Water			Sanitation			
	Communal Standpipe	Yard tap (between 4 households)	In-house water connection	Communal VIP Latrine	Shared Flush Toilet(between 7 households)	Flush toilet in the yard	In-house flush toilet
Capital cost	1,317,526,943	4,375,107,653	5,600,137,796	70,601,142,857	113,142,857,143	198,000,000,000	792,000,000,000
O&M cost	131,752,694	437,510,765	560,013,780	7,060,114,286	11,314,285,714	19,800,000,000	79,200,000,000
Useful life	20	20	20	20	20	20	20
Discount rate	8	8	8	8	8	8	8
PMT	-134,193,029	-445,614,378	-570,386,404	-7,190,882,345	-11,523,849,913	-20,166,737,347	-80,666,949,388
Annual capital costs	134,193,029	445,614,378	570,386,404	7,190,882,345	11,523,849,913	20,166,737,347	80,666,949,388
Annual O&M	131,752,694	437,510,765	560,013,780	7,060,114,286	11,314,285,714	19,800,000,000	79,200,000,000
Total annual costs	265,945,724	883,125,144	1,130,400,184	14,250,996,631	22,838,135,627	39,966,737,347	159,866,949,388
Cost /paying household / month	74.87	248.63	318.24	4,012.10	6,429.66	11,251.90	45,007.59

Target households =114,000 household, Paying households = 213,000 households

Table D-6: Summary cost of investment

Level of Service Options	Cost per paying household(UGX / household / month)	Cost per paying household(as used in survey)
1 tap for every 200 people and communal elevated VIP latrines	4,087	4000
Yard tap and shared flush toilet for every 7 households	6,678	7000
In-house Water Tap and shared flush toilet for every 7 households	11,570	12000

Table D-7: Health sector cost of diarrhoeal treatment

Average percentage of diarrhoeal cases that sought treatment, A = 67.5% (UBOS, 2007).
Average number of cases per incident, B = 2.1
Cost of treatment, C = 28,000 UGX per case
Total population = 2000000

	Diarrhoeal incidence (No. / 100 people) D	No. of treated cases E = D*A	Tot. costs / diarrhoeal case / yr F = E*B*C	Cost / taxpaying household / month
Communal facilities	60	40.5	2,381,400	2,682
Shared facilities	20	13.5	793,800	894
Yard facilities	20	13.5	793,800	894
In-house facilities	5	5.4	317,520	358

(UBOS, 2007)

Table D-8: Attributes used in the Stated Preference survey

Level of Service	Diarrhoeal Infections (/100 people/ month	School Days Lost due to Diarrhoea (/100 children/ month	Springs that Comply with Water Quality Standards (/ 100 Springs)	Cost of Diarrhoea to the City (UGX/hh/month)	Cost of Improvement (UGX/hh /month	Location of Informal Settlement to be Improved	Payment vehicle
1 tap for every 200 people and communal elevated VIP latrines	60	2.5	10	2,682	4,000	Near your neighbourhood	utility bill
Yard tap and shared flush toilet for every 7 households	20	1.4	30	894	7,000	In another division of Kampala	local property tax
In-house Water Tap and shared flush toilet for every 7 households	20	0.5	60	894	12,000	In another district in Uganda	dedicated fund

Table D-9: Impact of non-user value on benefit studies (Kampala data)

	Communal	Shared	Yard
Calculation of costs			
Number of beneficiaries (No. of households)	104,000	114,064	114,064
Annualised installation costs (UGX / facility / month)	139,557	207,742	368,041
Tot. Annual installation costs (UGX / household / year)	14,513,928,000	23,695,883,488	41,980,236,731
Tot. monthly installation costs (UGX / household / month)	1,209,494,000	1,974,656,957	3,498,353,061
Calculation of benefits			
Total incidence per year	131,040	143,721	143,721
Health system costs (UGX / household / month)	2682	894	894
Health system costs saved (UGX / year)	6,854,570,270	3,175,200,000	3,175,200,000
Patient costs saved (63% self-medicate) (UGX / year)	908,107,200	995,984,035	995,984,035
Value of time saved from reduced illnesses (UGX / year)	270,252,702,720	29,640,484,888	29,640,484,888
Value to society (per non-poor households) (UGX / household / month)	16,528	13,063	18,588
Total value to society (non-poor households=213000) (UGX / year)	42,245,568,000	33,389,028,000	47,510,928,000
Total annual benefits (UGX / year)	320,260,948,190	67,200,696,923	81,322,596,923
Benefit cost ratio	22.07	2.84	1.94
Annual cost per non-user beneficiary (UGX / year)	68,141	111,248	197,090
Cost per person reached (UGX / year)	2.91	1.41	1.13
Value of non-user benefits as a portion of total benefits	13%	50%	58%
Value of time as a portion of total benefits	84%	44%	36%

APPENDIX E

This appendix presents background information and calculations done in preparation for the surveys and for the analysis of the Cape Town data

CAPE TOWN

Table E-1: Income distribution in the City of Cape Town

Income Category (Rand per month)	Proportions % (GHS, 2008)	No. of Households
0 - 2499	50%	470,358
2500 - 9999	35%	327,806
> 9999	15%	141,239
TOTAL		939,403
Population that earn above R2500 a month		**469,045**

(CoCT, 2009)

Table E-2: Distribution of households in the City of Cape Town.

	As at 2009
Population	3,572,221
Households	902,279
Household categories	
Formal including 150,000 backyard households	785,396
Informal	116,883
Backyard	150,000
Informal +backyard	266,883
Target population	469,045

(CoCT, 2009)

Table E-3: Producer Price Index (PPI)

Year	PPI
1995	2.48
2009	1.01

(StatSA, 2010)

Table E-4: Absolute number of diarrhoeal cases in Stellenbosch

	Mild	Moderate	Severe	TOTAL	Unit Costs (2001)
No. of cases	37750	3350	840	41940	
% of treated cases	8	63	100		
Treated Cases @ clinics	3020	2111	840	5971 (14%)	32.1
Treated cases @ hospitals				232 (1%)	875

(DWAF, 2001)

Calculations for the Attributes

i) Determination of the number of diarrhoeal cases treated in clinics, D_c

$$D_c = 14\% * DIR * Household_{Beneficairy} \quad (1)$$

where D_C is the number of diarrhoeal cases treated in clinics; C_C is the average cost of treatment at a clinic; 14% is the percentage of diarrhoeal cases that are treated at clinics; and $Household_{beneficiary}$ is the number of beneficiary households.

ii) Determination of the number of diarrhoeal cases treated in hospitals, D_H

$$D_H = 1\% * DIR * Household_{Beneficairy} \quad (2)$$

where D_H is the number of diarrhoeal cases treated in hospitals; C_H is the average cost of treatment at a hospital; 1% is the percentage of diarrhoeal cases that are treated at hospitals; DIR is the diarrhoeal infection rate; and $Pop_{beneficiary}$ is the number of beneficiary households.

iii) Total cost of diarrhoea at health centres, COD_H

$$COD_H = D_C * C_C + 3 * D_H * C_H \quad (3)$$

iv) Total costs per paying population, COD

$$COD = COD_H / 469000 \quad (4)$$

where COD_H is the cost of diarrhoea at health centres; and 469000 is the estimated paying households.

Table E-5: Cost of diarrhoeal disease

Level of Service	Health Agency	No. treated cases	Unit costs	Total costs	Cost borne by Respondent HH, 2001	Cost borne by Respondent HH, 2009	Total Cost borne by Respondent HH
Communal facilities (population = 117000+150000)	Clinic	55318	32.1	1,775,700	3.79	6	13
	Hospital	2150	875	1,880,832	4.01	7	
Shared facilities (population 150000, incidence rate 364/1000)	Clinic	31091	32.1	998,022	2.13	4	8
	Hospital	1208	875	1,057,110	2.25	4	
Yard facilities (population = 150000, incidence rate 284/1000)	Clinic	24258	32.1	778,676	1.66	3	6
	Hospital	943	875	824,778	1.76	3	

Table E-6: Cost of investment for water and sanitation levels of service

	Supply service	Unit costs – capital 2009	Unit costs – O&M 2009	Tot costs – capital 2009	Tot costs - O&M 2009
Water	Standpipe (more than 1 tap /20 dwellings)	147	14	147	14
	Yard tap	4,616	508	4,616	508
	In-house water connection	5,893	847	5,893	847
Sanitation	Flush Shared / 5 Households	978	72	978	72
	Aqua privy, shallow sewers	4,500	600	4,500	600
	Conventional sewerage	10,250	1,100	10,250	1,100

(CSIR, 2000)

Table E-7: Water revenue from residential customers

Current demand, Ml/d = 226; Free basic services, Ml/d = 46; Indigent free basic services, Ml/d = 15

	Water demand %	Tariff, R/kl	Water Revenue	Sanitation Demand, %	Tariff R/kl	Sanitation revenue	Total Revenue	% of Total Revenue
Residential	67	8	904,320	67	8	618,659	1,522,979	70%
Non-residential (institutional, government)	33	7	394,641	33	6	219,286	613,928	30%
Total			1,298,961	116		837,946	2,136,907	

(CoCT, 2007: CoCT, 2009:200)

Table E-8: Annualised costs of level of service interventions

Description	Water Supply			Sanitation		
	Communal Tap	Yard tap	In-house water connection	Flush Shared / 5 Households)	Aqua privy, septic tank	Conventional sewerage
purchase price	147	4,616	5,893	978	4,500	10,250
O&M cost	14	508	847	72	600	1,100
useful life	20	20	20	20	20	20
discount rate	8	8	8	8	8	8
PMT	R -15	R -470	R -600	R -100	R -458	R -1,044
Annual capital costs	15	470	600	100	458	1,044
Annual O&M	14	508	847	72	600	1,100
total annual costs	29	978	1,447	171	1,058	2,144
% of revenue from residential	20	685	1013	120	741	1501
Cost per household. month	0.95	32.48	48.04	5.69	35.13	71.16

Table E-9: Summary cost of investment

Level of Service Option	Cost to Medium Income Household (R / household. month)	Cost to High Income Household (R / household. month)
1 tap for every 20 dwellings and a shared flush or container toilet for every 5 households	2.57	4.06
1 tap per household and a shared flush toilet for every 5 households	14.81	23.35
1 tap and a flush toilet in the yard of every household	26.24	41.37
In-house water and flush toilet	46.26	72.94

Table E-10: Attributes used in Stated Preference Survey

Level of Service	Diarrhoeal infections / 1000 people /month	Polluted rivers and streams (/ 100)	Additional amount of money required to provide this service (Rand/household / month)		School days lost / 1000 children / month	Tax money spent on medical care for diarrhoea (Rand/month)	Location of informal settlement to be improved	Payment Vehicle
			Middle Income Households	High Income Households				
1 tap for every 20 dwellings and a shared flush or chemical toilet for every 5 households	30	30	R 0.00	R 0.00	10.42	R 13.10	Near your neighbourhood	Municipal bill
1 tap per household and a shared flush toilet for every 5 households	27	20	R 14.81	R 23.35	9.33	R 7.36	In another suburb of Cape Town	Local property tax bill
1 tap and a flush toilet in the yard of every household	24	10	R 26.24	R 41.37	8.25	R 5.74	In another province of South Africa	A special fund set up for this purpose

Table E-11: CORRELATION MATRIX

	DIR	POL	LOC1	LOC2	LOC3	PV1	PV2	PV3	COST	SDL	COD	MCOST	SHARED	OWN	SQ	OTHER
DIR	1.00	0.68	-0.07	-0.02	0.09	-0.13	0.09	0.04	0.60	0.77	0.45	0.43	-0.86	0.86	0.00	0.00
POL	0.68	1.00	-0.08	0.01	0.07	-0.10	0.07	0.02	0.55	0.67	0.38	0.39	-0.84	0.84	0.00	0.00
LOC1	-0.07	-0.08	1.00	-0.50	-0.50	0.03	0.00	-0.03	-0.08	-0.05	0.01	-0.05	0.08	-0.08	0.00	0.00
LOC2	-0.02	0.01	-0.50	1.00	-0.50	0.03	0.08	-0.11	-0.03	-0.07	0.06	-0.02	0.00	0.00	0.00	0.00
LOC3	0.09	0.07	-0.50	-0.50	1.00	-0.06	-0.08	0.14	0.11	0.12	-0.07	0.07	-0.08	0.08	0.00	0.00
PV1	-0.13	-0.10	0.03	0.03	-0.06	1.00	-0.48	-0.50	-0.08	-0.12	-0.15	-0.07	0.12	-0.12	0.00	0.00
PV2	0.09	0.07	0.00	0.08	-0.08	-0.48	1.00	-0.52	0.01	0.06	0.17	0.00	-0.08	0.08	0.00	0.00
PV3	0.04	0.02	-0.03	-0.11	0.14	-0.50	-0.52	1.00	0.07	0.05	-0.03	0.06	-0.04	0.04	0.00	0.00
COST	0.60	0.55	-0.08	-0.03	0.11	-0.08	0.01	0.07	1.00	0.63	0.34	0.18	-0.68	0.68	0.00	0.00
SDL	0.77	0.67	-0.05	-0.07	0.12	-0.12	0.06	0.05	0.63	1.00	0.41	0.45	-0.84	0.84	0.00	0.00
COD	0.45	0.38	0.01	0.06	-0.07	-0.15	0.17	-0.03	0.34	0.41	1.00	0.24	-0.49	0.49	0.00	0.00
MCOST	0.43	0.39	-0.05	-0.02	0.07	-0.07	0.00	0.06	0.18	0.45	0.24	1.00	-0.47	0.47	0.00	0.00
SHARED	-0.86	-0.84	0.08	0.00	-0.08	0.12	-0.08	-0.04	-0.68	-0.84	-0.49	-0.47	1.00	-1.00	0.00	0.00
OWN	0.86	0.84	-0.08	0.00	0.08	-0.12	0.08	0.04	0.68	0.84	0.49	0.47	-1.00	1.00	0.00	0.00
SQ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OTHER	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table E-12: Impact of Non-user Value on Benefit Studies (Cape Town data)

	Communal	Shared	Yard
Calculation of Costs			
Number of beneficiaries	67 441	116 883	266 883
Annual installation costs per facility (R / year)	121	805	1 426
Tot. Annual installation costs (R / year)	8,160,420	94,090,815	380,575,158
Calculation of benefits			
Diarrhoeal incidences (No. /1000 people / year)	364	324	284
Total incidence (No. / year)	24,549	37,870	75,795
14 % that will seek treatment at clinics	3 437	5 302	10 611
Treatment costs at clinic(R / year)	220 644	340 376	681 243
1 % that will seek treatment at hospitals	245	379	758
Treatment costs at hospitals (R / year)	1 288 807	1 988 180	3 979 226
Health system costs saved (R / year)	1,509,451	2,328,556	4 660,469
Patient costs saved (85% self-medicate) (R / year)	625,992	965,687	1 932,767
Value of time saved from reduced illnesses (R / year)	7,990,776	6,611,454	5,232,132
Value to society (per paying households) (R / household / month)	32.06	88.59	61.04
Total value to society (paying households=496000) (R / year)	180,432,903	498,608,697	343,563,916
Total Annual benefits (R / year)	190,559,121	508,514,395	355,389,283
Benefit cost ratio	23.35	5.40	0.93
Annual cost per non-user beneficiary	17	201	811

APPENDIX F

This appendix presents the ethics form.